SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME VII AUGUST, 1908 NUMBER 2

# EXCISION OF THE RECTUM FOR CANCER

## REPORT OF A CASE IN A FEMALE, WITH IMPLANTATION OF THE SIGMOID INTO THE ANUS. ILLUSTRATIONS OF SURGICAL ANATOMY OF THE OPERATION. ANATOMICAL STUDIES RELATING TO A PROPOSITION TO EXCISE RECTUM, UTERUS, AND PART OF THE VAGINA, EN MASSE, ABOVE THE PELVIC FLOOR

BY WILLIAM C. LUSK, M. D.

Assistant Visiting Surgeon to Bellevue and St. Vincent's Hospitals; Professor of Clinical Surgery at the New York University and Bellevue Hospital Medical College

(Anatomical research from the Anatomical Department of the New York University and Bellevue Hospital Medical College)

EXCISION of the rectum, which is aiming more and more at thoroughness in the removal of the disease by the now almost universal use of the abdominal route, either alone or usually in combination with the sacral or perineal approach, has not as yet had its technique sufficiently elucidated by anatomical illustration and description, so that one essaying to undertake this most complicated operation can be guided intelligently in his necessary preliminary rehearsals on the cadaver, though individual operators from their personal anatomical studies and wide clinical experience have acquired great dexterity in the performance of the operation.

The following case of cancer of the rectum actuated the writer to pursue a course of investigations to establish the operation of excision of the rectum on a definite anatomical basis. In the case here considered eradication of the malignant disease was incomplete, and the studies were made with a view of determining the possibilities of a wider removal of the pelvic tissues in cancer of the rectum, the verdict on the practical applicability of which the writer refers to other students of the subject. Anyway, the writer feels that he is making no mistake in furnishing this contribution to the anatomy of the pelvis, and that the work may at least stimulate a train of thought for an improved operative technique in the removal of the rectum.

### HISTORY OF THE CASE

E. M., age 53. Admitted to Bellevue Hospital August 21, 1905. Morphine eater. Family history negative.

*Present history.* Since January, 1905, has noticed blood in stools and has had dull pain in the rectum which is more severe on movement of the bowels. Thinks she has lost over thirty pounds since January.

*Examination.* A hard, ulcerated tumor anteriorly situated in the rectum, its lowest palpable limit being one and one-half inches above the internal sphincter, from which level the tumor extended upward for about four inches.

*Pathological report.* Colloid carcinoma.

*Operation,* September 6, 1905. The approach was both through the coccygeoperineal region and a median cœliotomy wound. The former region was exposed by a horseshoe incision through which the coccyx was removed, and the levator ani split in the median line. The sacrum was not resected. Figs. 1 to 14 show the surgical anatomy of the approach to the rectum through the coccygeoperineal region and indicate the steps of excision by this route. In Fig. 25 are seen the relations, within the peritoneal cavity, of the grooved director introduced from below through the cul-de-sac in Fig. 13. The peritoneal attachment of the bowel in the line of

the director and the corresponding one on the left side were severed from above through the median abdominal incision, after the sigmoid loop had first been divided with a cautery between two clamps, the mesosigmoid cut across opposite the site of bowel division, the superior hæmorrhoidal vessels ligatured, and the space in front of the sacrum entered by cutting through the peritoneum and underlying fasciæ in front of the promontory. The peritoneal reflection onto the uterus, which was thickened, was cut close to the uterus. The bowel below the disease was severed through the posterior wound. A clamp was made to grasp the rectum just above the internal sphincter, and the muscular coats were cut through below it down to the submucous coat which was then peeled away from the internal sphincter, clamped low down at about the pecten and severed with a cautery above the clamp. The proximal end of the sigmoid, closed with the clamp, was drawn down into the posterior wound, and, after having been then liberated the necessary amount by division of the mesosigmoid, was brought through the sphincters and sewed to the cut anal margin. The clamp on the sigmoid had had the handles cut away, so that it could be drawn through the anus. It was left on the bowel until the following day for the purpose of averting infection. The mesosigmoid was about five inches, and the loop of sigmoid about fifteen inches, in length. The sigmoid had been severed about four inches above the site of entrance of the supeior hæmorrhoidal vessels, at which situation the mesosigmoid had the greatest length. To allow the proximal end of the bowel to be brought out through the anal canal, it was necessary to free three inches of its extremity by severance of the mesosigmoid, which it was the attempt to perform at a sufficient distance from the gut to preserve its circulation. The lengthening of the bowel was much hampered by the inclusion of the peritoneum in the ligatures which had a tendency to gather the cut edge into folds. The mobilized bowel gave the appearance of being well nourished throughout its entire extent. A cigarette drain having exit at the tip of the sacrum was laid along the bowel to the internal sphincter, and over it up to its site of exit the levator ani was sutured. The skin flap was sutured in place with silkworm gut, leaving an opening for the drain. The line of suture was sealed with collodion and then covered with rubber tissue, the edges of which were made to adhere to the skin with chloroform.

*Pathological examination of specimen.* Both the peritoneal reflection onto the uterus and the sites (Fig. 2, L R) of tying off the lateral attachments of the rectum were invaded by cancer. Longitudinal sections of the lower end of the amputated bowel taken from two different places, one on either side, showed healthy tissue in all the coats well below the area of disease.

*Early course.* Clamp readjusted after thirty hours, allowing enough of an opening in the bowel end for the insertion of a tube. Up to this time the occlusion of the bowel had caused no symptom of intestinal obstruction. The bowel end implanted in the anal canal sloughed, and on the sixth day fæces came through a fistulous opening which had formed in the vagina as well as alongside the drain.

Highest temperature was 102 degrees on the fifth day. The patient recovered with a stricture of the anal canal. On her discharge from the hospital, December 22, 1905, the stricture would admit a number seven Wales bougie; the fistula into the vagina was about one-half an inch in diameter and no escape of fæces took place there unless a little during defæcation; the contractility of the external sphincter was not at all impaired.

*Subsequent course.* The patient returned in May, 1906, suffering from fæcal impaction, the result of an extreme narrowing of the anal outlet. Up to two weeks previous to her return she said she had had no trouble other than a very slight soiling of the parts, which had caused her no discomfort. The stricture was easily dilated sufficiently to give complete relief and establish comfort. Examination showed that the posterior vaginal wall from the cervix down to the fistulous opening was hard, thickened, and smooth. The anal canal was the seat of a hard annular cicatrix through which the tip of the finger could feel similar hardened tissue above. The anal margin and region of the external sphincter were perfectly soft. The latter part of June she suffered another partial obstruction which was relieved again by dilating the anus. She continued to be very comfortable.

The patient died August 17, 1906. The autopsy showed the posterior vaginal wall tremendously thickened by disease, and invasion of the parametria and iliac glands with extension of the disease upward along the aorta. Right hydronephrosis with dilatation of the ureter down to a point where the latter entered a mass of thickened tissue near its site of entrance into the bladder.

*Observations.* All of the cancerous tissue was not removed. A wider dissection close to the pelvic wall, combined with a hysterectomy and the simultaneous excision of the posterior and lateral portions of the vagina together with the mass of lymphatic tissue associated with both vagina and rectum on either side, would seem to have been the operation of least magnitude which could have given the slightest hope of accomplishing a complete local removal of the disease in this patient. The division of the mesosigmoid for the liberation of the proximal extremity of bowel, done in accordance with no established technique, was evidently made too close to the gut. This liberation of the bowel should have been done through the abdominal approach.

### COMPARISON WITH THE OPERATION FOR CANCER OF THE CERVIX UTERI

Systematic wide excision of cancer in pelvic surgery by the abdominal approach has been

done chiefly for that affecting the cervix uteri with which cancer of the rectum, from its similar central site of origin in the pelvis and tendency to lateral invasion, can be profitably compared. W. A. Freund (1) first performed abdominal excision for cancer of the cervix with removal of cancerous glands. Ries (2) first, and afterward Wertheim (3) and Mackenrodt (4), each devised a special technique for the wide removal of cancer of the uterus with its associated lymphatics and glands by the abdominal approach. Other advocates of wide excision of the pelvic tissues for cancer of the uterus by the abdominal route are von Rosthorn, (5) Döderlein (6), and Sampson (7). Ries (8) has reported six cases of carcinoma of the cervix who survived operation by his method, all of whom lived five years and over. One of the cases subsequently developed carcinoma of the breast, and another nine years after the operation, carcinoma of the inguinal glands. Wertheim, in 270 cases of cancer of the cervix uteri operated upon by his method, obtained freedom from recurrence for from four to five years in sixty to seventy per cent of the cases, which he says was "a result hitherto attained by nobody else." Mackenrodt, in 42 selected cases—19 with macroscopically free parametria, and 23 with clinically involved parametria to an extent not reaching beyond a condition where the mass was freely movable—operated on by his technique of the abdominal method, obtained 29 cures, or sixty-nine per cent, extending over a period of from one to four years. In fifteen of these forty-two cases cancer was found in the glands, of whom ten had remained sound within the period of time mentioned, some of them over the third and fourth year periods. Mackenrodt used these latter figures as an argument for gland removal. He insists on thoroughness of removal of all tissues liable to invasion, and compares the results of an insufficiently wide removal by the abdominal route as about equal to those of a well-executed total extirpation by the vaginal route. He points out the great importance of removing the obturator glands, and associated with them the internal inguinal (see Fig. 34 *k k*), which he says are the most frequent seat of metastases, and from their deep protected situation are often overlooked. He cautions against air embolus in cutting through veins. He once himself wounded the external iliac vein which he sutured and obtained union of the wound without thrombosis. Von Rosthorn believes that the invasion of the glands with cancer furnishes a most powerful argument in favor of the abdominal route. He once resected the external iliac vein, which was involved in the cancerous process, without any resulting ill to the patient (9). He resects the ureters if they are invaded. Döderlein has tabulated the percentages of cures of carcinoma of the cervix operated upon by nine operators by the vaginal route, showing an average cure for five years of one-third of the cases. These results would seem to belong to the class of cases in which the disease was all localized around the central lesion (see p. 116). They are instructive for comparison with the figures showing about double the number of cures for this condition when the parametria and glands are removed together with the tumor by the abdominal route. Döderlein has employed the abdominal route since 1902. Sampson practices wide local excision in cancer of the cervix, removing all of the tissue out to the pelvic wall on either side and resecting the ureters in cases where the ureteral sheath is involved in the disease, with subsequent implantation of the proximal ureteral ends into the bladder.

In view of these attainments in wide radical excision of cancer of the cervix uteri, it would seem reasonable and proper to voice as well a proposition for as wide as possible removal of the tissues associated with the rectum, when the latter is the seat of cancer. In the female the close association of the structures entering the rectum and vagina from the side wall of the pelvis, which lie in a common cellular tissue, as well as the existence of an, at least sometimes, demonstrable lymphatic connection between the rectal and vaginal walls (see p. 136), would seem, in anteriorly situated carcinoma of the rectum anyway, to make co-excision of the parametrium uterus and all of the structure possible of the vagina a necessary procedure, in order to be able to extend any hope whatever of eradicating the disease. Mackenrodt (10) has already performed such an operation, regarding which he says: "The close association of the rectum with the vagina and parametrium, the impossibility of an anatomical separation of the

lateral paraproctium from the parametrium, the frequency of recurrence in the parametrium which I have seen following extirpation of the rectum alone, are the reasons why I no longer remove a cancerous rectum without the vagina together with the parametrium and uterus and the whole Douglas' sac." Mackenrodt performs this operation through an abdominal wound. He removes as well the associated glands, and mentions sewing the proximal bowel end into the sphincter. He mentions elsewhere (Zeitsch. f. Geb. u. Gyn., liv, 1905) the liability of involvement of the rectum in late cancer of the cervix. Pryor (11) reported two cases of cancer distinctly involving both rectum and vagina, in which he removed the anus and the rectum, the adjoining portions of the vagina and vulva, the uterus, and the parametria, in one mass.

### LESSONS FROM PATHOLOGICAL STUDIES IN CANCER OF THE UTERUS

The most painstaking microscopic studies of the tissues invaded in cancer of the uterus have been made by a number of observers, the parametria and glands having been cut and examined in serial sections so that the smallest metastasis might not be overlooked, and the knowledge thus obtained can in reason be regarded to have a similar application to the rectum and its lymphatic associations affected by the same disease.

Baisch (12) has written up the subject of lymphatic and glandular invasion in cancer of the cervix uteri. He refers to the work on this subject of Kermauner and Laméris (13), Kundrat (14), Krömer (15), Schauta (16), and Winter (17), besides his own.

Kermauner and Laméris demonstrated that parametria which feel soft and smooth may be carcinomatous, while thickened, infiltrated parametria and glands may be simply inflammatory, containing no carcinomatous disease whatever. This confirmed similar observations of Veit and Mackenrodt and was in keeping with the findings of Baisch himself, as well as of Wertheim (Journ. Surg. Gyn. and Obs., Jan. 1907). Pankow (18) cites a case of cervical cancer which was fixed on both sides to the pelvic wall and in front to the bladder, following operation on which it was found that both parametria and a section of the bladder wall which had been removed were absolutely free from carcinomatous changes. Kundrat has classified cancerous invasion of the parametria in cancer of the cervix into three types:

1. Where it has extended from the seat of primary disease directly into the parametria, the lateral projections forming one continuous mass with the cervix.

2. Where carcinomatous metastases are found either in the lymphatic glands or lymphatic vessels at a distance from the primary focus, with healthy tissue intervening.

3. Where the first and second forms exist in combination.

Kundrat, from serial sections in 160 cases of cancer of the cervix, found the parametria carcinomatous in 55 per cent; Kermauner and Laméris in 33 cases of cancer of the cervix found parametrial invasion in 57.5 per cent; and Pankow in 67 cases, in 68.6 per cent. Kundrat, in 5 cases of beginning cancer of the cervix, found the parametrium invaded, and again in advanced carcinoma of the cervix the parametrium was at times found healthy.

*The frequency of glandular invasion* has been studied. Schauta found, by making serial sections in 50 cases who had died of cancer of the uterus, that the glands were carcinomatous in 32 cases, or 64 per cent, one-third of the cases even in the last stages of the disease still remaining free from gland metastases. However, the condition of the glands in operable cases is of greater practical importance. Baisch, from the statistics of a number of operators who made careful microscopic examinations, estimates that disease of the glands exists in operable cancer of the cervix in one-third of the cases. von Rosthorn (19), in 140 cases of cancer of the uterus operated upon by him abdominally, found that about 40 per cent had glandular involvement. Wertheim, (20) in 345 cases of cancer of the cervix operated upon abdominally, found the regional glands cancerous in 28 per cent; and in a further 30 per cent of the cases the glands were enlarged but not invaded with cancer. Pankow reports 71 cases of cancer of the cervix operated upon by the abdominal route in which carcinomatous glands were

found in 28.2 per cent of the cases, and in 25.3 per cent of the cases enlarged glands were found which were not carcinomatous but of a simple inflammatory nature. Mackenrodt (21) is authority for the statement that, in 95 per cent of all early cases with diseased glands, the disease is limited to the glands of the pelvis. von Rosthorn (22), in 33 cases of cancer of the cervix on which he operated, found the lower lumbar glands invaded in 9 per cent. Toward the solution of the question as to the possible *invasion of unenlarged glands*, Kermauner and Laméris contribute their findings of carcinomatous invasion of glands which were often hardly linseed size, in 7 out of 33 cases. The percentage of cases of invasion of the glands in the presence of clinically free parametria, as compared with that where the parametria are thickened, has been investigated by Winter, Kundrat, Kermauner and Laméris, Krömer, and Baisch. Their results show that the frequency of glandular invasion in clinically uninvolved parametria varied from 5 to 20 per cent, while in cases having carcinomatous parametria it was about 50 per cent. Baisch concludes that "the clinical integrity of the parametria and the small size of the growth is no guarantee for the non-invasion of the glands." From the above considerations it can be seen how impossible it is in early operable cases of cancer of the uterus to make even a reasonable conjecture as to whether or not gland invasion has already taken place, so that the rational treatment of all these cases naturally resolves itself into the wide removal at the pelvic wall of all the cellular tissue and glands associated with the central seat of disease which might possibly be involved. This can be done only by the abdominal route. Of interest relating to the matter of *recurrence* is the statement of von Rosthorn (23) that "encapsulated cancer nests can remain latent for a long time, only to develop after the expiration of many years (10 to 12) and again become active as a result of irritation."

Wertheim (24) states that in the majority of the cases in which cancerous glands have been removed there has been recurrence of the disease, though some of the cases were free from recurrence after four to four and a half years.

### PROFESSIONAL AND LAY MEASURES TO SECURE EARLY RECOGNITION OF DEVELOPING CANCER OF THE RECTUM

In order to bring substantial relief to the human suffering caused by this frightful disease, it would first be important that steps be taken to bring patients to early operation, and then that wide excision of the disease be practiced on the thus-secured operable cases. No disease is perhaps more insidious in its onset and often in its progress, than is cancer of the rectum. The patient with cancer may be complaisant concerning the discharge of a little blood from the bowel, which is often the only symptom he remarks, or, sorry to relate, the physician himself may be the one who is to blame for a faulty diagnosis. Literature is full of complaints against doctors who have made the diagnosis of hæmorrhoids for a condition which, instead, was beginning cancer, and one's personal experience bears out the truth of such statements. The writer would like to cite one particular extreme instance of professional shortcoming in this regard, where the patient had been suffering from bleeding and discharge from the rectum with an increasing constipation over a period of eight months, and not one of the half dozen doctors whom he had consulted had so much as made a digital examination of the bowel. Lorenz (25), bearing on the responsibilities of the profession in this matter states: Time for early operation "is generally missed not on account of the sparcity of the symptoms but frequently through the guilt of the physician." How often is it said, "treated for months for hæmorrhoids without having had a digital examination." The interior of the rectum can so easily be brought directly before one's vision by the use of the electric proctoscope, and a specimen of any diseased tissue removed through the latter for microscopic examination, that the only valid excuse for not instituting these measures for the examination of a suspicious condition of this region, would be one's inability to secure the examining instruments, and this likely could take place only in a remote country practice. Also through the round sphincterscope by the use of reflected light, with the patient in the knee-chest position and having his back arched forward, which posture on the introduction of the speculum allows air distension of the

rectum, a fair view of the interior of the latter can be obtained for a distance higher than the finger can reach. The physician at least, if the proper instruments are not to be had, should never neglect in any case of hæmorrhage or discharge from the bowel, to palpate the bowel with his finger as high as it will reach.

Winter (26) reports an organized attempt in East Prussia to bring women with cancer of the uterus to early operation and thereby to improve to a maximum the chances for cure of the disease. By instructing the doctors and midwives to make early examinations and by the education of the public, the operability of the cases rose from 62 per cent in 1902 to 74 per cent in 1903, and where from 1898 to 1902, only 58 per cent of the cases consulted a physician within three months after the first appearance of symptoms, in 1903, this figure was raised to 90 per cent. In this country there is a Committee on Cancer of the Uterus, of which Dr. John G. Clark (27) is chairman. They report that "in from only 3 to 6 per cent of the total number of cases of cancer of the cervix is an operation instituted early enough for the surgeon to circumvent the disease," and recommend the instruction of women in this matter.

These steps taken to combat cancer of the uterus are certainly in the right direction, and a concerted movement for the early recognition of rectal cancer similar to that organized in East Prussia for the uterine disease would indeed be a proposition indicative of progress.

### OPERATIVE METHODS

The rectum has been excised by the sacral or by the perineal route alone, by either of these two in combination with the abdominal approach, and by the abdominal route alone. It has also been excised occasionally by the vaginal route. As regards the extent of the removal of tissue, the height of the invasion of the disease has been the usual consideration, while there seems to have been little thought given to lateral invasion. Mackenrodt is the one who has particularly called attention to the liability of invasion of the parametrium and vagina in rectal cancer in the female, which structures he has removed, together with the uterus and diseased rectum, for the purpose of making the operation more radical.

The choice of the operative method for excision of rectal cancer has, in the past, generally been made to depend upon the situation of the local growth. Thus perineal excision was done for anal cancer; sacral excision or excision by the posterior approach was done for ampullary cancer not involving the anus; and the combined operation by both abdominal and posterior (or perineal) approaches only for high-seated rectal cancer, which could not so well, or at all, be reached from below. Recently it has become appreciated that by the use of the abdominal route a higher removal of the lymphatic structures running along the rectum into the mesosigmoid, which are liable to invasion in all forms of rectal cancer, could be effected, and that the percentage of permanent cures was thereby increased, so that this route has now come into much more general use.

Sasse (28), speaking in favor of the combined operation, has observed that rectal extirpation by the vaginal or sacral route can seldom be made complete. He says: "It seems to me that the chief requirement of the carcinoma operation, namely, the extirpation of the tumor together with the associated glands and lymphatics, is not sufficiently taken into account." Rehn (29), after quoting Gerota's description of the lymphatics of the anus and rectum, concludes that the smallest cancer of the rectum or a carcinomatous disease of the anus requires an extensive removal of the rectum and of the glands up to at least the peritoneal fold. He favored the abdominal route, however, only for high-seated cancers of the rectum. Kraske (30) on the combined operation says: "The chief advantage in my opinion, is that one can thoroughly remove all the lymphatic glands which lie behind the rectum and in the mesorectum." Gouillioud and Faysse (31) regard the combined method as all-important in excision of neoplasms of the rectal ampulla. They say: "The excision by the perineal route is therefore insufficient; one is not sure of going beyond the limits of disease and of removing suspected glands." C. H. Mayo (32) says: "It is evident that any operation to be effective must remove the entire chain of glands with all the fat as high as the promontory of the sacrum." Also as the discomforts of sacral, perineal, and gluteal ani have made the sequels of rectum extirpation

often ones to be dreaded, where science has aspired instead to re-establish the continuity of the bowel and provide the patient with normal sphincteric control, the abdominal route has had the additional advantage of providing a better approach for the liberation of the sigmoid flexure with a view to preserving its nutrition. The especial deterring influence in the use of the abdominal route was the greater primary mortality, though as the facts are studied, the fatal outcome seems to have affected more particularly males, and them to a somewhat remarkable degree. (See "Mortalities and cures in the combined method," p. 120.) The mortality in excision of the rectum is influenced particularly by two factors, one the condition of the patient and the other the skill of the operator. Some operators in their series of reported cases have chosen to operate on some pretty advanced types of the disease which has rendered their mortalities greater than they would otherwise have been. Some operators report in the course of time improving mortality records, which, allowing that the selection of cases is no different, would argue for the acquisition by them of an increased skill from their experience and study. Thus Kraske (33) in a first series of 29 cases of sacral excision of the rectum had a mortality of 34.5 per cent, but in a second series of 51 cases he had a mortality of only 9.8 per cent. Rotter, in a first series of 62 resections had a mortality of 38.4 per cent, but in a second series of 19 resections he had not a single death. An analogy can be found in the comparison made by Pankow (34) of the mortality rate following abdominal extirpation of the uterus, parametrium, and glands in cancer of the cervix uteri, with that following vaginal extirpation. By the abdominal method Pankow has shown that, in the hands of experienced operators, the mortality is now even not quite so great as by the vaginal method; that the percentage of cures is much greater; and that by the use of this route it has become possible to include a larger proportion of the cases among the operable number. Many of the operators mention their studies of the operation of rectal extirpation on the cadaver, which is an undoubted necessity to develop a facility in its performance. On the skill of the operator also is dependent the ability in suitable cases to resect the bowel, re-establishing the continuity of the canal so that the normal sphincters can be utilized. This operative procedure seems formerly to have been much more of a contributory factor in increasing the mortality rate than it is at the present day. (See "mortalities of amputation and resection," below).

The facts of interest regarding the various operative methods relate chiefly to the primary mortality, the permanency of cure, the functional results, and the technique. In relation to the technique of performing this operation interest is mainly centered around the questions of the extent of removal of the disease and the disposition of the bowel ends.

*Primary Mortality and Permanency of Cure in Sacral Method*

| Operator | Mortal per cent | No. of all cases | Cures | | Late recurrence |
|---|---|---|---|---|---|
| | | | No. | Per cent | |
| Kocher | 28.5 | 35 | 10 | 28.5 | 3 |
| Hochenegg | 9.19 | 174 | 30 | 17.3 | 5 |
| Küster | 25.2 | 95 | 16 | 16.8 | 2 |
| Krönlein | 11.1 | 63 | 10 | 16. | .. |
| Czerny | 11.2 | 196 | 34 | 17.4 | 13 |
| Kraske | 18.7 | 80 | 11 | 13.7 | 3 |
| v. Bergmann | 32 | 125 | 16 | 12.8 | .. |
| Madelung u. Garré | 10 | 53 | 6 | 11.3 | 2 |
| Schede | 32 | 53 | 6 | 11.3 | .. |
| Albert | 13 | 153 | 16 | 10.4 | 3 |
| v. Mikulicz | 25.7 | 66 | 6 | 9. | 2 |
| v. Eiselsberg | 11.1 | 45 | 4 | 8.8 | 2 |
| Poppert | 6.4 | 63 | 17 | 27. | |
| Rotter | 32 | 43 | 12 | 28.1 | |

Hochenegg (35) in 1902 published a table of statistics showing the operative mortalities and percentages of cures of various operators following "radical" excisions of the rectum — all evidently by the posterior route. The table is herewith reproduced with the results of Poppert and of Rotter — Petermann's (36) report — added, and Czerny's results altered to correspond to the latest report by Küpferle (37).

The cures in the table are all reckoned on a minimum three year basis, and the late recurrences are those that developed later than three years after operation. Hochenegg believed the differences in the results of the various operators to have been due to the sort of operation performed, the care of the wound, and the after-treatment, and not to the choice of cases. He had always been particular to personally conduct the after-treatment of his own cases. Küpferle was impressed with the in-

completeness of removal of the disease in many cases. From a study of cases who had died of so-called recurrence, he was convinced that in about 90 per cent the disease had not been completely removed at operation.

Hartwell's (38) collection of 46 cases of rectum excision by New York surgeons, all but one of which having been done by either the sacral or the perineal route, showed a primary mortality of 26 per cent, and of 44 of the cases who had been heard from 5, or 11.4 per cent, had survived over three years, and 10 others were living having severally survived for periods each less than three years.

*Mortalities of amputation and resection of the rectum compared.* The following table shows the comparative mortalities of amputation and resection of the rectum, done through a posterior approach.

| | Amputations | | Resections | |
|---|---|---|---|---|
| | Cases | M'tality Per cent | Cases | M'tality Per cent |
| Wolff (v. Bergmann) | 60 | 14.7 | 65 | 47.7 |
| Poppert | 35 | 8.6 | 28 | 3.6 |
| Küpferle (Czerny) (peritoneal cavity opened in all) | 41* | 14.6 | 23 | 26. |
| Lieblein (Wölfler) | 28 | 10. | 22 | 27. |
| Lorenz (Hochenegg) | 90 | 8.9 | 25 | 12. |
| Petermann (Rotter). 1893-1903 | 17 | 23.5 | 26* | 38.4 |
| 1903-1906 | 23 | 4.8 | 19 | 0. |
| Hartmann (39) | 12 | 0. | | |

* Includes implantations.

In this series of figures the marked betterment in the results following the supposedly more dangerous of these two operations, shown by Rotter and by Poppert, argues favorably for the proposition that further improvement in technique is within the reach of attainment. von Bergmann (Wolff's (40) report), operating upon 80.6 per cent of all cases, many of whom had extensive involvement, had the highest mortality of any one from resection, 47.7 per cent, while for amputation he had a mortality of 14.7 per cent, which figures have had their influence to favor the use of the latter method. On the other hand, Poppert (41) recently has had results which not only show an exceedingly small mortality from resection (1 death out of 28 cases and that from heart failure, which cases probably included his 8 implantations), but which even reverse the ratio of comparative mortalities so that the figure for resection stands at 3.6 per cent, while that for amputation is 8.6 per cent. None of these cases died from sepsis. Also, Rotter's recent series of 19 resections with not a single death establishes an equally enviable record. In v. Bergmann's 60 amputations there was not a single case of infection, and in the 65 resections only a small number of infections occurred. He attributes the success in avoidance of infection to the use of iodoform gauze. Küpferle's cases comprise only those in which the peritoneal cavity was opened, and cover a period of four years. Classified as resections by Hochenegg are cases of circular and partial suture in the wound and cases of invagination with suture.

*Mortalities in implantation method:* Hochenegg, 19 cases of implantation by the posterior route, with one death, or 5.3 per cent mortality; Kümmell (42), 14 cases of implantation by the combined method with 6 deaths, or 42.8 per cent mortality; Wölfler (Lieblein's report), 14 cases of implantation with 5 deaths, or 35.7 per cent mortality.

*Mortalities and Cures in the Combined Method*

| Combined Method | Males | | Females | |
|---|---|---|---|---|
| | Cases | M'tality Per cent | Cases | M'tality Per cent |
| *Amputation.* | | | | |
| Quénu (Hartmann's article) | 7 | 100. | 9 | 11.1 |
| Schloffer's collection (omitting Quénu's cases) | 8 | 87.5 | 8 | 0. |
| *Resection.* | | | | |
| Kraske | 7 | 42.9 | 3 | 0. |
| *Amputation or Resection.* | | | | |
| Rotter | 10 | 42. | 6 | 50. |

A comparison of the mortality rates in the sexes following this operation has generally shown a very low percentage for females, while the percentage for males has been extraordinarily high. Rotter's statistics alone of those here cited reverse this ratio. Quénu (43), in a report of female cases of carcinoma of the rectum on whom he had performed the operation devised by Gaudier on the cadaver, of abdominoperineal amputation with the formation of an iliac anus, cites 7 instances, with 1 death from operation of a case previously debilitated by hæmorrhages. One case died several months after operation in which, at autopsy, the liver was found to be invaded. Four cases had survived for from 3 to 5 years, and 1 case 18 months, without recurrence. Hartmann (44) suggested that the greater mortality in man was probably due to the more frequent wounding of the rectum in freeing it from

the membranous urethra and prostate. The writer (45) has illustrated photographically how the separation between rectum and urethral triangle can be made anatomically. Hartmann mentions an evidently later list of Quénu's cases, including males, which has been here used for the tabulation. Rotter (46) reported that of his 25 cases (14 coccygeal anus, 11 attempted re-establishment of continuity of gut) of rectal extirpation by the combined method, 11 died primarily, giving a mortality of 44 per cent, 7 dying from infection. Eleven cases were alive and sound, three of them from 3 to 7 years since operation, and 8 under 3 years since operation. W. J. and C. H. Mayo (47,) in 26 cases of rectum extirpation by the combined method, had a primary mortality of 26.9 per cent. Kraske (48), in trying to account for the greater mortality in the combined method than in the sacral, explains that cases were operated on by this method from whom it would have been impossible to remove the disease by the posterior route alone. Also the long duration of the operation carries a part of the blame. He believes that an increase in one's experience is helpful. His deaths came mostly in the first half of his patients; the last 3 cases, which belonged to the most difficult, all lived.

*The Question of Rectal Resection*

As regards the frequency with which the anus can be saved, statistics go to show the comparative rarity of cancer affecting this region. Thus Tuttle (49) cites 602 cases of cancer of the anus and rectum, in which the anus was chiefly involved in 6.7 per cent of the cases; the portion of bowel between the internal sphincter and the tip of the coccyx in 26.3 per cent; and the portion between the tip of the coccyx and the rectosigmoidal junction opposite the third sacral vertebra in 67 per cent. Quénu and Hartmann (50), making a little different anatomical arrangement of the regions to which cancer of not too long duration is limited, classified these cases in three groups. The first group included those cases in which the upper limit of the disease did not reach higher than the coccyx; the second group, those cases which, leaving the sphincteric portion intact, did not exceed 8 to 9 cm. in height; and the third group, those whose inferior limit is situated 8 or 9 cm. from the anus, the lower extremity being at the peritoneal cul-de-sac. They quote from German authors 45 cases of cancer thus classified, of which 13 cases or 28 per cent were of the first type; 22 cases or 49 per cent, of the second type; and 10 cases or 22 per cent, of the third type. In their personal experience consisting of 16 cases, 5 cases or 31.5 per cent were of the first type; 9 cases or 56 per cent of the second type; and 2 cases or 12.5 per cent of the third type. These figures of Quénu and Hartmann show the greater frequency of cancer involving the rectal segment proper over that situated above or below. All the figures taken together show that in from 67 to 71 per cent of the cases the sphincters were free from gross evidence of involvement. The possibility, then, of retaining the sphincters would depend upon whether the disease were sufficiently high-seated to sever the bowel above the sphincters in healthy tissue.

Lorenz (51) has made the following observations from Hochenegg's clinic on the location of cancer of the rectum: Out of 128 cases of primary rectal cancer in 11 (6 men and 5 women), the carcinoma affected the portio analis, in all of which cases the disease had grown far up into the ampulla. Of 81 cases, in 34 the growth was circular and in 47 isolated. Of the latter, once the situation of the cancer was not recorded; 28 times the cancer was on the anterior wall; 9 times the cancer was on the posterior wall, 5 times on the right, and 4 times on the left wall. In the 34 cases of circular cancer the growth was situated at the height of the sphincter tertius or still higher, and all but 5 of the cases came to observation as already considerably stenosed rings. Of the 128 cases, there were 96 in whom the upper limit of the disease could be reached with the finger and 32 cases in which it could not be reached. Granted, therefore, that in a large proportion of the cases of rectal cancer the sphincters are not invaded, the question arises in these cases whether, when the proximal end of bowel can be sufficiently liberated to effect an anastomosis, to attempt resection of the bowel with a view of restoring normal function to the patient, or whether, on account of the difficulties of technique, to habitually sacrifice this specially functionating portion of the

anatomy, substituting therefor an artificial anus. Contention is made on both sides, though the number of those in favor of retaining the healthy sphincters far outweighs the opposition.

Kraske (52), the originator of circular suture of the bowel ends through the posterior approach, has championed the method ever since its inception. Hochenegg (53) devised the implantation and invagination methods through the posterior approach. Lorenz (54) gives Hochenegg credit for devising the implantation method in 1889. Moulonguet (55) is said to have independently reported a similar method in 1890 devised by himself. Heineke modified the implantation method by splitting the anus open behind and sewing it up again after the bowel had been fixed in position. Lieblein (56) claims originality for the invagination method also for Wölfler. Maunsell (57) proposed a method of invaginating the portion of bowel containing the disease before its resection, and Trendelenburg (58) first practiced such an operation and after him Kümmell (59). Weir (60) first practiced Hochenegg's invagination method with suture of the intestinal ends outside the anus following excision of a high rectal cancer entirely by the abdominal route. Also Abbe (61) has reported a case by this method and C. H. Mayo (62) four cases.

Trendelenburg (63), Edebohls (64), and Schloffer (65) have each sewed the bowel ends together following the removal of high rectal cancer through the abdominal approach alone. Mann (66), Czerny (67), Kocher, Braun (68) and Sasse (69) have employed the Murphy button.

Kocher, Ball (70), Czerny and others have employed partial suture of the bowel ends with a posterior opening left for drainage, a method first tested by Kraske but later given up by him. Other advocates of preserving the healthy sphincters are Rotter (71), Körte (72), Wölfler (73), Rehn (74), Jaffé (75), Küster, Poppert (76), Küpferle (77), Czerny (78), Kocher (79), Prutz (80), Krönlein (81), and v. Eiselsberg (82).

Edebohls has contended for saving the sphincters when possible, for the purpose of preserving besides their function, the pelvic floor, support from which would be of particular importance in an operation like the one here proposed for wide removal of the rectum, uterus, and part of the vagina, which leaves only just enough peritoneum to be drawn together over the top of the pelvic cavity.

In the presentation of the following annotations from the literature on rectum extirpation, the different methods of bowel union have been considered separately and the results of individual operators in the practice of the same operation compared, as furnishing a fairer basis for estimating the prognosis in an operation about which there is so much diversity of opinion and in the performance of which the personal experience of the operator is so important a factor.

*Circular suture through a posterior incision.* Kraske (83), in an early communication, after recounting his difficulties in trying to establish a technique to secure bowel union following resection of the rectum, concludes "nevertheless, I always return to the view that the most desirable aim must be and must remain, the primary union of the bowel ends by the circular stitch." His first two cases of resection of the rectum with end-to-end suture of the bowel segments, died of peritonitis due to leakage. He then added the important step of closing the opening into the peritoneal cavity around the drawn down segment of bowel with an iodoform gauze tampon (Berlin kl. Wochenschr. xxi, 1887, p. 899), and tried sewing together only the anterior halves of the bowel ends, at the same time fastening the free edge of the upper segment in the wound in the soft parts with strong lateral sutures for the purpose of fixing the bowel and to aid in shutting off the peritoneal cavity. The subsequent healing of the fistula thus produced was troublesome and therefore unsatisfactory. He then, independently of Hochenegg's work, experimented with invagination of the proximal end through the anus, in one method after dilating the sphincters to paralysis drawing down the line of circular bowel suture inserted through the posterior wound, through the anal canal, and temporarily suturing it to the perianal skin, and in another method drawing the proximal bowel end through the anal canal undenuded of its mucous membrane, and then fixing the

former externally. In all these cases gangrene of the proximal bowel end occurred from too strong traction on it. He then returned to the method of circular suture, depending upon careful washing of the bowel before operation, and opium afterwards, to prevent or diminish fæcal interference with union. He then "succeeded several times in obtaining a perfect primary union of the bowel ends but in most cases the bowel opened posteriorly to a greater or lesser extent, usually at the end of the first week. This giving away of the stitches was not due to the movements, since in cases where a preliminary colostomy had been performed it occurred just the same. The difference between this fistula, produced by the breaking down of the suture line, and one created at operation, was that the former practically always closed spontaneously by early strapping or by introducing a supporting suture. The closure of the fistula was sometimes rendered more difficult by a stenosis and spurs at the line of union of the bowel ends, due to the scar contraction behind the bowel drawing the latter toward the sacrum. The more carefully he conducted the healing of the granulating wound surfaces, the less frequently marked stenosis occurred, and among his later cases there were some in whom it was difficult to detect the line of union with the exploring finger. At this time (1900) Kraske reports that out of 65 cases who survived operation there were 39 in which the union of the bowel ends following resection of the tumor, and the restitution of a perfect function were striven for. Twenty-three times this intention was completely realized. In 16 cases a small fistula remained, but in all the cases the function of the sphincter was throughout normal." In this series there were 80 cases operated upon with a mortality of 15, or 18.7 per cent. Kraske cautions against cutting too close to the disease in the desire to save the sphincters, and in the conduction of the healing of the wound not to remove the iodoform gauze tamponade too soon.

Kraske (84), in a later communication, speaking from the standpoint of one who had given long, careful study to the problem of saving the healthy sphincters in removal of the rectum, takes up the defense of his position, as he says, as a matter of duty. The article brings out certain points in his experience which are instructive. He begins: "I must say that he who, in extirpating a carcinoma of the rectum, removes the patient's sound sphincter and thus robs him unnecessarily of an important organ which might readily have been left, commits a great wrong and sins against the first precept of operative surgery." He does not regard that it has been shown that the operation of resection is really more dangerous than the technically simpler amputation (see mortalities from amputation and resection, p. 120), and states that he completely agrees with Körte (85), who says in this connection: "It would be a greater satisfaction to me to save 80 per cent of my cases with a sphincter than 85 or 90 per cent without it." Regarding his practice of cutting the bowel across above the sphincters (see "Kraske's resectio recti," p. 131) before freeing the diseased portion above, Kraske stated that in his last 120 cases of carcinoma extirpations, performed in the great majority of cases by resection, he had not seen a single case of phlegmon or peritonitis. Though there is danger in the procedure, it can be met with a high degree of safety. In answer to the objection of fistula formation, he acknowledges the difficulties of uniting the resected bowel ends and his own failures and explains that the frequent failure to obtain primary union was due to a partial necrosis of the upper bowel end as a result of tension and a disturbance of nutrition. The avoidance of forcible blunt stripping and tearing, and the careful ligature of the superior hæmorrhoidal artery, are important factors in preserving the nutrition in the mobilized bowel. Where he has used the abdominal route for the mobilization of the bowel above the tumor he has most always seen a primary union of the sutured ends occur. Regarding impairment of the sphincter function, he says "that by the resection of the bowel, or by the preliminary operation the integrity of the sphincter is permanently injured or destroyed, is an entirely arbitrary, purely *a priori* supposition." The pudic nerves must be carefully protected from injury. If these nerves of one side are destroyed, anatomists agree that those of the other side will then extend their function to beyond the middle line. He calls attention to the work of Goltz and R. Ewald (86) who removed

the entire spinal cord in dogs up to the neck, and then, keeping the animals alive for a year, found that the sphincter ani, in the beginning paralyzed, again became able to functionate, while the skeleton muscles completely degenerated to connective tissue strings. So that there would be a possibility that the function of the sphincter would not be permanently lost even in transverse sacral resections of considerable extent. The restitution of the sphincter function apparently came about through connections of the internal pudic nerve distribution with the pelvic plexus of the sympathetic.

Kraske introduces a touch of consideration for the less experienced. "Pains, care, and perseverance are often in high measure requisite, and when I contemplate the time of my own first efforts and troubles, though I cannot approve of so doing, I can nevertheless understand how in the face of the difficulties encountered one may lose his courage and patience, and entirely give up the attempt to retain the anal portion." He concludes with an enumeration of 14 selected cases on whom he had performed resectio recti by the sacral route for high-seated cancer, all of whom had perfect sphincter function and all of whom had survived operation for over 3 years, 5 of them having survived between 5 and 10 years. He says in this connection: "All disadvantages such as greater technical difficulties, longer time of healing, etc., which can be charged against the practice of this conservative procedure done in place of the mutilating total extirpation of the rectum, are one hundred times outweighed by the perfect result." Other functional and operative results of resection of the rectum with suture of the ends through the posterior wound are reported by Wolff (v. Bergmann), Poppert, Küpferle (Czerny's clinic), Lieblein (Wölfler), Petermann (Rotter), and Prutz. Of v. Bergmann's 7 cases of resection with circular suture who lived beyond the three year period, 5 had complete continence and 2 relative continence. Poppert reports 20 cases of rectal resection with circular suture of the bowel ends, 10 of which healed primarily, 6 had a fæcal fistula which closed and 4 had a small fæcal fistula which persisted. Poppert cites the results of Vogel-Schede, and of Schneider-Garré. Schede, in 14 cases of bowel suture who survived the operation, twice obtained primary union; 6 cases had temporary and 6 permanent fistulæ. Schneider-Garré had 6 cases of bowel suture, 1 of which healed primarily, 3 had fistulæ which closed, and 2 had fistulæ which had not closed. Poppert, after mentioning the liability in Hochenegg's implantation method (which he had employed in 8 cases) of the occurrence of incontinence for thin stools and gas, concludes that the surest operative method by which to attain normal sphincter function for the patient is, according to his personal experience, by resection with subsequent circular suture of the bowel ends according to Kraske.

Of 20 of Czerny's cases in which resection with circular suture was performed, 8 had complete continence, 10 continence for formed stools, and 2 incontinence. Wölfler had 1 case which healed entirely after primary fistula formation, and had complete continence. Petermann reports from Rotter's clinic that in 6 cases of resection with primary bowel suture in which Rotter's posterior flap was not used, there resulted one instance of primary union, and in 8 cases in which Rotter s posterior flap was used there resulted 7 instances of primary union. The writer has not been able to find a description of Rotter's flap. v. Eiselsberg mentions a pedicled skin flap for the closure of a fistula following circular suture of the bowel, with which he obscurely associates the name of Rotter. The flap is first allowed to granulate and then is strapped over the fistulous opening. Prutz (87) reports 7 cases of circular suture of the bowel ends, in 2 of which primary union was obtained. Two had temporary and 2 permanent fistulæ. One died. Hochenegg's cases of circular suture and invagination are classified together so that they cannot be differentiated. Picking out from Schloffer's collected cases of resection by the combined routes, those in which the bowel ends were united by suture through the posterior wound, there were found to be 9, 7 of whom died; of these Mikulicz's case died of abdominal hæmorrhage; Kraske's 2 cases, of pulmonary œdema and of weakness; Sasse's case, of peritonitis; and Schloffer's, of the same. Durets' 2 cases both died, though neither of them from sepsis. Kümmell's case with half suture of the ends

had primary healing and Rotter's case healed. The mortality following resection is considered further elsewhere (p. 000), in comparing it with the mortality following amputation.

*Implantation and invagination through the posterior approach.* Hochenegg (88) cautions against trying to save an anus when the disease extends too close to it. He, too, at the beginning had much trouble with the circular suture of the bowel ends, whereupon he devised the *implantation method* of joining the upper bowel end with the sphincter portion, in which, after first stretching the sphincters and then denuding the anal canal of its mucous membranes, he drew the upper end of the bowel, consisting usually of the lower end of the flexure, through the anus and fastened it outside. For greater security he then placed a second row of stitches suturing the bowel within the wound. This method he employed in cases where sufficient bowel could be mobilized to be drawn readily through the anal canal, but for cases where, on account of too great tension on the proximal bowel, the implantation method seemed impossible, he performed what he called the *invagination method* also devised by him, which consisted in first telescoping the upper extremity of bowel through the lower after the latter had been first inverted by traction on its upper border so that the upper border protruded below the anal opening, then sewing together the edges of the two ends thus approximated, drawn outside the anus, and finally letting the suture line recede to above the sphincters. The sutures were thus inserted entirely from within the bowel. Wölfler, in practicing invagination after first sewing the ends together outside the anus, introduced a second row of stitches through the posterior wound to add security to the first. Hochenegg reserved circular suture of the bowel ends directly in the wound only for those cases where, from an insufficient length of bowel, neither implantation nor invagination were possible. Regarding the outcome of his methods of bowel suture in practical experience, he says: "Notwithstanding this improvement in suturing, it nevertheless happens in certain cases that the suture tears in places and then fæces pour into the wound. This occurrence would take place usually after several days, at a time when the wound was already granulating and therefore infection very unlikely. To this statement I would subscibe one other, namely, that out of my 62 cases of resection with intestinal suture I lost but one case from stercoral phlegmon." He reports that of his cases of resection he obtained complete continence in 21 of those operated on by the implantation method and in 5 of those operated on by suture in the wound. In a little later communication Lorenz (89), reporting results obtained in Hochenegg's clinic, compares the functional results obtained by the implantation method with those by resection. Classified as resections are cases of circular and of partial suture of the bowel ends in the wound, and cases of invagination with suture. Of 17 cases of implantation who survived operation and could be communicated with, 8 were completely, and 5 partly, continent, and 4 incontinent. Of 22 resections who survived operation, 8 were completely, and 6 partly, continent, and 8 incontinent. The percentages are shown comparatively in the following table:

| Result | Implantation Per cent | Resection |
|---|---|---|
| Complete continence | 47.1 | 36.4 |
| Partial continence | 29.4 | 27.2 |
| Incontinence | 23.5 | 36.4 |

Lieblein reports 6 of Wölfler's cases of implantation who survived operation and could be traced. Two were completely continent, one was incontinent for wind, 2 were incontinent for fluid stools and wind, and 1 case had the stitch tear completely out on account of tension. Schloffer mentions 6 cases of implantation done through the combined routes. Of these, in a case of his own the bowel end sloughed and the patient died of peritonitis. Sonnenburg's (90) case healed entirely, following the primary formation of a sizable posterior fistula. Kümmell's (91) 2 cases of implantation, one of the transverse colon and one of descending colon, both healed apparently without fistula formation; in the former the anus "functionated perfectly," in the latter continence was not perfect, which was attributed to a recurrence of tuberculous ulceration for which disease the operation was performed. Czerny's case died of peritonitis and Sasse's (92) case had gangrene of 8-10 cm. of the bowel, necessitating the formation of a sacral anus. Petermann reports

8 cases of implantation by Rotter, 3 of which healed primarily, also two cases of *invagination* with primary healing in both. Küpferle reports that out of the 238 cases in Czerny's clinic, Hochenegg's invagination method was employed once and then the bowel suture sloughed completely out and the patient died of a severe sepsis. Libelein reported 4 cases of invagination by Wölfler in which his second row of sutures were introduced through the posterior wound. Two of the cases had complete continence following the closure of primary fistulæ, 1 case had a fistula through which most of the stool would pass, and 1 case experienced sloughing of the proximal bowel end. Several cases of invagination through the abdominal route alone, are mentioned below.

Lorenz, discussing the sequel of gangrene of the bowel end in the implantation method, says that, if one takes care for the proper nourishment of the bowel and avoids tension on it, then extensive gangrene and retraction of the same is hardly ever experienced, yet slight disturbances of the circulation with resulting formation of small fæcal fistulæ are not infrequent. Hochenegg notes that, following a successful bowel suture, there may result incontinence for thin stools, which he attributes to impairment of the sphincters from stretching. Lorenz suggests the loss of reflex excitability as one reason to account for it. Kocher in the latest edition of his book states: "On first principles I cannot consider it advisable to excise the mucosa of the anus like Hochenegg, since this is as necessary for retaining the reflex mechanism as are the muscles."

The writer would like to call attention in this connection to the fact that a similarly resulting incontinence following the Whitehead operation for hæmorrhoids has been attributed by Andrews (93), to the removal of the specially sensitivized pecten containing sensory nerves of spinal origin.

Lorenz mentions having practiced in one case of implantation *Heincke's procedure* of splitting the anus open posteriorly with resuture of it after the bowel had been sewed into the anal canal. Paralysis of the sphincter resulted, though there was primary union in the wound. He says that this modification makes the operation only a little easier and seems readily to lead to incontinence. Küster (94), practices this method after a preliminary colostomy. He says that union results, as a rule, with complete or almost complete continence. Kocher says splitting the anus impairs its function. On general principles the splitting of the anus would seem ill-advised since a restoration of its function must then depend upon primary union in the reunited ends, which must always be of uncertain occurrence.

*Implantation through the abdominal route alone.* Schloffer cites 3 implantations by the abdominal route alone, 1 done by Czerny and 2 by Ball, all of which cases died. Schloffer yet believes this operation can be done successfully, provided there is not the slightest traction on the bowel. The freedom from any tension whatsoever seems to be an absolute necessity in this method. Ball (95) in a later article recommends implantation by the abdominal route and says that in 3 cases he had no difficulty in bringing the bowel down through the anus. He does not specify the results.

*Resection without the anus of tumor prolapsed through it by abdominal route.* Maunsell's proposed operation devised on the cadaver, consisted in first cutting the anus open posteriorly and then by the abdominal route freeing the bowel, prolapsing the portion containing the tumor to without the anus, transfixing the prolapse above the tumor with long needles, amputating below the needles and suturing together from outside the anus the bowel ends thus held together. The operation is possible only in the case of small, and consequently very early tumors. Kraske (96) had had in his 10 resections by the combined method, no case in which the operation could have been contemplated "on account of the extent of the diseased piece of bowel and of the infiltrated retrorectal tissue." It would certainly seem that, with the need generally for a high section of the bowel to ensure thorough removal of the disease, in order to permit of the necessary amount of mobilization of the bowel there must be not only a tumor of small size, but also a sigmoid loop of considerable length. The extraperitoneal portion of the rectum must be mobilized down to the site of attachment of the levator ani into the anus. Trendelenburg has performed a similar opera-

tion once and Kümmell 6 times, the difference being that these operators simply stretched the sphincters to permit the prolapse of the tumor, instead of cutting them. Trendelenburg sewed the bowel ends together with mattress sutures supported by a continuous button-hole stitch whipped around the edges and grasping the same deeply. Gauze drainage through abdominal wound. A fæcal fistula developed which soon closed. Of Kümmell's 6 cases, 1 was sound after 6 years, 1 died of intercurrent disease after 8 years and the others have been sound between 1 and 2 years.

*Invagination by abdominal route alone.* Weir removed the diseased segment of bowel and performed sigmoidorectal anastomosis by invagination of the bowel ends through the anus, by the abdominal route alone, in 3 cases. Drainage posteriorly. One case died of persistent diarrhœa. Two lived, in both of whom it was necessary a few weeks later to use a number 7 or 8 Wales bougie. In one of these, having planned to perform the Maunsell operation, Weir had cut the anus backward with a resulting somewhat prolonged impairment of function. In Abbe's case "the result was admirable." Mayo does not specify the results in his 4 cases. Schloffer reported a case of invagination by the abdominal route in which he tied the bowel ends drawn without the anus, around a prosthetic appliance made of bone. The patient died of collapse on third day. There was circumscribed necrosis of the intestine in the region of the resection. De Quervain (97) anastomosed the transverse colon to the rectal segment by the invagination method with resulting gangrene at the seat of anastomosis, which De Quervain believed took place in the distal segment.

*Resection with suture by abdominal route alone.* Schloffer believes that rectum resection with suture of the bowel ends entirely by the abdominal route was inaugurated by Trendelenburg (98). The latter stated before the German Surgical Society in 1897: "I have repeatedly operated on cases of high-seated cancer in this way successfuly." A case was then living four years after operation. In Edebohls' case the lower line of section was 9 cm. above the anus. An enlarged uterus containing a four months' fœtus had to be removed to secure access. The proximal bowel end was closed with a gauze tape tied with a view of its easy undoing through the anus, and was invaginated into the inverted upper portion of the wall of the rectal segment, so that its serous surface came in contact with outer raw surface of the distal bowel. The area of apposition of the bowel segments was about 2 cm. in width and the invagination was maintained by two rows of interrupted chromic sutures, 20 in each row. About 2 cm. of the proximal end projected free into the rectal segment. Gauze drain through the vagina. The gauze constriction around the proximal extremity, at the conclusion of the operation, was untied through the anus and a free evacuation of the bowels occurred soon after. Result: Primary union throughout. Schloffer, in 3 cases of high carcinoma at the peritoneal reflection, resected the bowel entirely through the abdominal route, sewing a serous covered upper end to a non-serous covered rectal end. The union was made by a double suture line of continuous stitches. The two rows uniting the posterior portions of the bowel ends were introduced first, the primary row being just outside the lumina and the second row uniting the segments from within their lumina. Schloffer in his first case included in his outer suture all around the line of union, the edge of the anterior peritoneal flap, and made a colostomy at the upper angle of the abdominal wound which ran parallel to the left Poupart's ligament. The bowel was cut 3.5 cm. below the disease which latter involved the peritoneal fold. Drainage of pelvic cavity from above with gauze around tubes. A fistula formed along drain sinus, which closed. The line of union could be felt 6 to 7 cm. above the anus and would admit two fingers. In his second case he made a preliminary anus præternaturalis in the transverse colon, sewed the bowel ends together with two rows of sutures, and drained from above. A diarrhœa developed which, discharging through the colostomy wound, infected the seat of abdominal operation below, and the patient died of sepsis. In his third case he mentions no colostomy. An inva led uterus was removed with the diseased bowel, the bowel ends were united with a double suture line, and tube and gauze drainage inserted both above, as well as below

through the vagina. Recovery uneventful. After healing, the line of suture could be felt about 3 cm. above the tip of the coccyx.

*Sigmoidorectal anastomosis by Murphy button.* Mann has reported 3 cases of this operation done through the abdominal approach, in which the Murphy "button was applied to the portion of the rectum below the resection where it was denuded of peritoneum, and yet 2 were successful." Küpferle reports from Czerny's clinic 3 cases of rectal resection by the posterior route in which the Murphy or the Friedrich-Murphy button was used. There arose each time fistula formation. In one case in which the Friedrich-Murphy button was used there arose, through decubitus pressure of the button on the bowel, a small fistula which closed in three weeks. In another case in which a Murphy button was used the bowel became necrotic at the line of union. Later, colostomy had to be performed on account of stenosis of the rectum. In the third case the Friedrich-Murphy button was used. Primary union did not result and Hochenegg's invagination method was secondarily made use of. Kocher states in his surgery that he has attained perfect union in resectio recti in the extraperitoneal portion, by the use of the Murphy button. He has tried using a large button and introducing through it by way of the anus a tube for drainage and washing. His preference is for circular suture without tension. At the German Surgical Congress of 1906, he mentions a case of rectal resection with Murphy button in which the subsequent function was perfectly normal. Braun through the abdominal route made the anastomosis with the Murphy button. He does not specify that the lower segment of bowel was extraperitoneal. He drained with gauze from above and installed an artificial anus. A small fistula resulted which later closed. Sasse by the abdominovaginal method resected the rectum, joining the bowel ends together by means of a Murphy button and a supporting row of stitches. On the ninth day a small fæcal fistula developed which closed on the tenth day.

*Principles of sigmoidorectal anastomosis.* From a consideration of the above cases of end-to-end anastomosis of sigmoid with rectum, it appears, *cæteris paribus*, that in those cases where broad phalanges of tissue were known to have been brought together, good union resulted. This is exemplified in Trendelenburg's case of abdominoanal resection in which mattress-sutures were used, in Edebohls' case (phlange 2 cm. wide) and in Sasse's case (Murphy button supported by suture). Edebohls, suturing through the abdomen had no fistula, and Schloffer in his third case of suture (double row of stitches) through the abdomen had a similar result. To obtain perfect union between these bowel segments it would also seem as though a good closure of the non-serous space at the site of attachment of the mesocolon to the bowel might be of importance. The stitch line should efficiently coapt the surfaces to prevent primary leakage. Rotter (99) presents the proposition that to prevent fæcal wound infection it is of great importance that the stitches should be introduced without tension. Lieblein states that the formation of fistulæ comes on too late — in their cases not before the fifth day — to be of dangerous import.

*Partial suture.* In rectal resection with suture Ball joins together only the fronts and sides of the bowel ends, leaving the posterior portion open for drainage. Kocher advises to leave 0.5 cm. of the bowel circumferences unsutured posteriorly, and from this site to make a longitudinal slit upward for the introduction of a tube. Küpferle reports that Czerny in 6 cases of resectio recti sutured together only the front portions of the bowel ends, the posterior portions being sewed into the wound as a provisional sacral anus. There was no death. Twice the existing fæcal fistula had to be closed by a plastic secondary operation.

*Choice of method of bowel anastomosis.* Kraske's circular suture of the bowel ends above the anus through a posterior wound is the method accredited with giving the best functional result, and with careful technique, and proper drainage it would seem can be practiced with due safety to the patient. The liberated proximal bowel end in this method is less liable to become gangrenous than in implantation because the length of the freed portion is considerably less.

Hochenegg's implantation method has a less complicated technique than circular suture, and, if necrosis does not occur, the drainage of

the bowel is better. The very great danger of sloughing of the bowel end with resulting stricture, and the liability of incontinence for thin stools and gas following a successful union, are its drawbacks. A sufficient length of proximal bowel together with its nourishing vessels, must be liberated to reach to the anal margin without the slightest tension. The sphincters must be stretched to paralysis or they will be liable to cut off the circulation in the implanted bowel.

The results of invagination have not been reported enough in detail to enable one to form a substantial idea of the value of the method from the literature on the subject. To secure extraanal apposition of the bowel ends, there should be in the distal segment a cuff of freed bowel above the internal sphincter, of sufficient length to be pulled out through the anus. In this connection it can be noted that Kraske in describing rectal resection by the combined method (see p. 131) has advised against freeing too extensively the supraanal portion of the distal segment in the interest of good nutrition of the part. Also, he has cautioned against ligature of the internal iliac arteries where the anus and lower rectum are to be left for anastomosis.

Kraske tried partial suture and gave it up. It would seem from the literature that, in complete circular suture, unless gangrene should occur, primary union anyway of the fronts of the bowel ends is to be expected, the posterior portion of the suture line being that which one looks to have break down when fistula formation takes place. So that in favor of complete suture rather than partial, it can be said that, in case primary union of the entire circumference should not take place, barring gangrene, the worst thing that would be likely to happen would be only what partial suture contemplates at the outset, namely, the formation of a posterior fistula, and that secondarily at a time when the wound surfaces would be in a granulating condition. Czerny suggested leaving a posterior fistulous opening in those cases where the tension was too great for complete closure.

*Actively opposed to saving the sphincters* under any circumstances are Wenzel, Witzel, Wiesinger, and Schuchardt. Quénu and many other French surgeons express a decided preference for amputation rather than resection. Wenzel (100) in a recent publication gives as his reasons for preferring amputation of the rectum to resection, that in the former there is a greater possibility of maintaining asepsis and that there is no distal segment left in which recurrence can take place. Also that there is no need for considering the circular suture, the tension on the bowel, and the nourishment of the proximal end. In substantiation of his reasons for fearing recurrence in the distal segment, he cites one such experience of his own and those of Jaffé (101) who pointed out that implantation metastases may occur in the lower segment following resectio recti. Jaffé's statement is that in 3 out of 30 cases of resectio recti he had seen implantation metastases occur in the lower part of the rectum. That the metastases were the result of implantation from above, he regarded as demonstrated by the facts that the growths appeared as quickly as a few weeks or months following operation, and that on microscopic examination they were found to consist of cylindrical cells in an area of flattened epithelium. He says: "Whoever knows the brilliant results of keeping the lower end, will not at all doubt that Kraske who takes an opposite view to many others, is quite right." Jaffé concludes that he does not wish to advise against retaining the lower end. Wenzel terminates with the expression, "nevertheless in each case we have sacrificed the muscular control apparatus only with deep regret."

Witzel (102) objects to resection of the rectum with suture of the bowel ends, on the grounds of the great danger of primary suppuration, the frequent partial or complete separation of the stitches with fistula formation, and the impairment of function of the retained sphincters. The function following resection, he claims, in man is always bad and in women in any case is no better than he has obtained by lateral high implantation of the bowel.

Wiesinger (103) in some cases of attempted resectio recti experienced the occurrence of gangrene of the proximal bowel end. He quotes Krönlein's statistics that in rectal excision more than one-half the postoperative deaths are due to sepsis, which he says is no accident but due

to the method. He claims, therefore, for resection great danger to life and liability of impairing the function of the sphincters. The comparative mortalities following resection and amputation are given above (see p. 120). Schuchardt (104) had had no favorable experiences with retaining the sphincters and, therefore, had given up further attempt to do so.

The preference of many French surgeons for amputation rather than resection by the combined method, seems to be based chiefly on its favorable outcome in women. (See "Mortalities and cures by the combined method," p. 120.) While the reported mortality from amputation by the combined method in the female sex is exceptionally low, the mortality in males, on the other hand, is exceedingly high — a male only exceptionally surviving the operation. In fact, the mortality following Kraske's resection operations by the combined method in males, can be seen to have been considerably less than the mortality following amputation by the combined method in the same sex by others.

TECHNIQUE

The writer having recently been an eyewitness to the performance of rectal resection by the posterior route by Hofrat Prof. v. Kraske, who had the great kindness to arrange to do this operation during a short visit which the writer was making at Freiburg, and believing that the technique employed might be of interest to others, has concluded to here recount the steps of this perplexing operation as he saw it done by this foremost investigator of its problems and most experienced advocate of its use. Kraske's own description of this operation is recorded in the Sammlung kl. Vorträge (neue folge 51–80), 1897–1900, p. 771. The case was one of ampullary growth, about four inches of bowel was resected, and the anastomosis made without division of the superior hæmorrhoidal vessels.

*Resectio recti by the posterior route, as performed by Kraske himself.* Female. Spinal anæsthesia. The patient at the beginning was placed in the right lateral position with hips raised on a cushion. The buttocks were brought to the foot of the table facing which the operator worked. Left parasacral incision running diagonally into or just beyond the median line at a point a little behind the anus. The knife was carried rapidly down in the line of the incision, cutting close alongside the sacrum and coccyx until the fascia propria recti was reached beneath the deep muscular structures. The upper part of the coccyx was then grasped between the blades of a bone-cutting forceps and cut across. Through this approach wide retraction could be gained and there was ample room for all the subsequent steps of the operation. The fascia propria recti was then pushed forward for two or three inches from the front of the sacrum and the space thus made packed with gauze. The operator next put his left index finger, specially gloved for the purpose, through the anus into the bowel, and with it as a guide cut through the fascia propria recti and rectum from behind at a level a little above the internal sphincter, which appeared to be about an inch below the tumor. The division of the bowel was made with short interrupted cuttings, after each of which the edge of bowel above and below was caught up with a heavy silk thread, the ends of which were tied together forming a loop, so that after the bowel was entirely cut across there was a row of traction loops attached to either end by means of which the two segments could be manipulated. A piece of gauze was now placed in the wound over the opening of the distal end to avoid soiling from this source, and for a similar reason a plug of gauze was pushed into the open end of the proximal segment and was held in place by tying together over it some of the opposite-placed traction loops. The wound was now temporarily packed with gauze, while the position of the patient was changed to a dorsal decubitus with hips elevated almost vertically on two or three firm cushions, the thighs being flexed and held by an assistant on either side. This elevation is so high that the portion of the back corresponding to the shoulder blades is about all that touches the table. The position is one that greatly facilitates the subsequent steps. The left index finger was now placed in the vagina, and over it as a guide the bowel was dissected free from the posterior vaginal wall, in so doing severing the attachment of the fascia propria recti to the latter on either side, until the cul-de-sac was opened into. The peritoneal opening was en-

larged laterally, the anterior peritoneal fold caught up by clamps, and two gauze strips, their ends dusted with a little iodoform powder, were laid through the opening into the peritoneal cavity, one having exit on either side of the bowel. The lateral bowel attachments opposite the cul-de-sac were clamped, evidently at the situation of the middle hæmorrhoidal vessels, and then tied and severed. The operator was careful not to raise the bowel very high from off the sacrum. The bowel was severed about an inch above the disease, in a line through the upper portion of the rectum where the latter had a partial peritoneal covering, so that the cut margin of the proximal segment had peritoneal covering only in front. The division of the bowel above the disease was effected by interrupted cuts, the margin of the upper segment as fast as it was thus liberated, being sutured to the distal segment below. The bowel was first opened into anteriorly in the line of division, through which opening the interior of the bowel was cleansed, and then the first stitch introduced, which was placed in the anterior median lines of the two bowel ends. The next stitches were placed one on either side of the first one, and then continued equally on the two sides for about three-quarters of the bowel circumference. All these stitches were tied on the inside of the bowel, and a goodly mass of tissue was included in each grasp of the needle so as to coapt broad surfaces along the line of repair. The stitches were tied as they were introduced. For closure of the remaining quadrant situated posteriorly, the stitches were placed outside the bowel inverting the edges of the mucous membrane. At this situation two rows of sutures were introduced, an outer row supporting the inner, and broad areas were brought together. All the sutures were of strong silk and interrupted. During the suturing together of the bowel ends a strip of gauze was laid in front of the line of suture, and at the finish removed. The two pieces of gauze previously inserted into the peritoneal cavity now protruded through the wound on either side of the bowel and were left in situ. The wound was finally packed on either side of, and behind, the bowel from below upward into the sacral concavity. One stitch brought the upper angle of the wound together. The operation was executed very rapidly and the patient was in no shock.

In Kraske's own earlier description of this operation he mentions placing in between those stitches, which were tied inside the bowel, other fine stitches coapting the edges of the mucous membrane.

*Czerny's circular suture.* Czerny (105) in rectal resection by the posterior route, employed two rows of stitches of which the front ones were tied from the interior aspect of the bowel and the posterior ones outside the bowel. The proximal bowel end, during the placing of the first stitches, remained closed by the elastic ligature applied at the line of bowel section. The bowel was provided with a thick rubber tube surrounded with gauze for drainage. In Küpferle's reported results from Czerny's clinic, he says that in performing circular suture in rectal resection, Czerny's stitch was used in most of the cases. These results have been noted above.

*Resectio recti by the combined method—Kraske* (106). Through the abdominal route the bowel above the tumor is freed, double ligatured, and divided with a cautery between the ligatures. The proximal end is surrounded with gauze and the distal ligatured end is inverted with sutures. The rectal segment is then partly isolated, while the proximal segment, liberated to a sufficient extent, is placed in the true pelvis surrounded by a gauze pack, and the abdominal cavity is thereupon provisionally closed with gauze tampons. After this the patient is laid in the right lateral position, and through a posterior incision the isolation of the rectum is continued downward to well below the tumor. Circular suture is performed coincident with severance of the rectum below the disease. The rectum is first cut through the front below the disease and immediately the lower lip of this cut is sewn to the corresponding situation of the drawn down bowel end which has been newly freshened. Then the transverse division of the bowel below the disease is continued with interrupted cuttings, following each of which, sutures are inserted joining corresponding points of the two ends together. This technique simplifies the suturing together of the bowel ends (cf. Kraske's resection by posterior route, see above). The sacral wound remains open and is filled with gauze tampons which

reach from the suture line to the peritoneal cavity. The abdominal wound is then closed. If inspection before closure is made from above, after the anastomosis has been made and the tamponade inserted below, Kraske says one can see no surface which is not covered with peritoneum. As regards ligature of the internal iliac arteries he calls attention to the fact that it is best done where total extirpation of the rectum and anus is performed, but that where the lower portion of the rectum and the anus are retained then the ligature of these vessels is naturally omitted in the interest of good nourishment of these parts. Regarding the preservation of good nourishment of the lower bowel end, he says that it is never judicious to free the bowel in front for more than 2–3 cm. beyond the lower boundary of the tumor.

*Rotter* in the combined method retains the continuity of the bowel until the end of the operation. He mobilizes the bowel from above, then closes the abdominal wound, and finally, through the posterior wound, after having sutured the Douglas pouch around the descended segment, removes the diseased portion of the bowel.

*Moynihan* (107) has practiced in high-seated, and recommends in low-seated, cancer of the rectum, the removal together with the tumor, of a wedge-shaped mass of lymphatic tissue, the base of which is situated along the sigmoid flexure and rectum and the apex at a gland at the site of origin of the inferior mesenteric artery. To accomplish this he divides the latter vessel high, sometimes even above the left colic branch, and the sigmoid high as well, and then to secure descent of the shortened proximal bowel end he liberates the colon to above the spleenic flexure. The operation is performed through a long median incision.

*Preliminary colostomy.* The idea that a preliminary colostomy, by diverting the fæcal discharges from the seat of bowel suture in rectal resection, facilitates union, is no longer generally entertained. The main indication for its use is stenosis of the rectum causing obstruction. Also Wiesinger and Küpferle recommend its use in high-seated, firmly fixed carcinoma. Wiesinger has called attention to the fact that in these cases, if a colostomy be performed, the tumor will gradually become movable from the resulting subsidence of the associated inflammatory infiltration.

Kraske (108) does not favor preliminary colostomy. He says: "The course of the wound is not essentially different from that without the preliminary colostomy, provided, of course, thorough preparation has been made. I must say that, according to my experience, the closure of the artificial anus is not a very simple procedure or one lacking in danger." In the year 1900, Hochenegg limited the indication for colostomy to absolutely inoperable carcinoma. Küpferle has said: "In practice one has seen many disadvantages of the preliminary colostomy. The duration of the confinement of the patient is increased several weeks; the drawing down of the bowel end in many cases is often accomplished with difficulty and with danger of circulatory disturbances; instead of one operation, three must be performed, and the closure of the colostomy fistula is often surrounded with perplexities. . . . In the Heidelberg clinic use was made of the preliminary colostomy only when obstructive stenosis was present, or if in very high-seated and firmly fixed carcinomata the possibility of performing a radical extirpation was for a time doubtful." Petermann says: "The preliminary colostomy . . . . we employ only in those cases where evidences of very severe stenosis exist." Wolff stated, in 1900, that the preliminary colostomy had not been used in v. Bergmann's clinic for years. Abbe (109) says: "The artificial inguinal anus had best always be made at the time of operation, and need not be done beforehand." Ball and Swinford Edwards recommend preliminary colostomy in cases of rectal stenosis. Hartmann never employs a preliminary inguinal colostomy. Rehn says, regarding a preliminary artificial anus for cleansing the bowel before operation: "The best and most careful emptying of the bowel gives no security against infection during the operation."

Where an abdominal incision is contemplated the very great danger of its infection from a preliminary colostomy must be an absolute contraindication to the employment of the latter in such cases. Schloffer reports one such case of infection and Edwards 2 cases.

Thus, at the present time the employment of this distressing feature of the operation has become pretty generally limited to the indications cited above.

In cases of need the writer would propose, on anatomical grounds, instead of performing a colostomy at the sigmoid flexure, the making of one at the spleenic flexure. Such anus can be placed laterally in the flank so that the discharges from it will have a tendency to gravitate toward the back, instead of over the front of the abdomen; it is situated at the most distant point possible from the seat of laparotomy, and it leaves the sigmoid undisturbed. The following procedure can be done anatomically.

*Proposed colostomy at splenic flexure.* Make a short incision from the tip of the left eleventh rib in a line directed toward a point on the right Poupart's ligament, at the junction of its outer fourth with its middle two-fourths. To form a fæcal fistula the parietal peritoneum is tacked to the external oblique and the splenic flexure sewed to it. A permanent artificial anus can also be constructed at this situation through a longer incision by severing the splenic flexure at its lower part, freeing the proximal extremity and turning it upward over the tenth costal cartilage and ninth rib beneath the external oblique muscle and bringing it out to the skin surface through an incision made over the eighth intercostal space. This would afford an opportunity for closure of the anus by compression of the bowel end against the chest wall. The distal extremity would have to be sutured into the flank wound for drainage of the bowel below.

*Primary closure of an implanted proximal bowel end.* This would apply to anal implantation or to the formation of a permanent colostomy, and is done for the purpose of securing limiting adhesions before fæcal soiling can take place. Mayo says that in forming an artificial anus, he leaves the end of the sigmoid completely obstructed for the first twenty-four hours. Ball regarding anal implantation says: "It is a good plan to keep the ligature on the proximal end of the intestine for forty-eight hours." The writer has successfully clamped the gut in cases of artificial ani until intestinal disturbances arose, which was from eighteen to thirty hours after the completion of the operation.

*Incisions.* Those for opening up the posterior route are considered at the end of this article. The abdominal incision which gives the broadest opening for exposure of the pelvic cavity is Stimson's (110) modification of Pfannenstiel's. This is a U-shaped incision outlining below the umbilicus a median flap which includes the anterior structure of the sheaths of the recti muscles. The point of the flap crosses the median line just above the symphysis pubis, while the arms of the U pass upward on the two sides a little within the outer edges of the recti sheaths. As the flap is raised there are exposed beneath, the recti and pyramidales muscles of the two sides, between which a median entrance is now made into the peritoneal cavity. If it be desired to enlarge the opening, the left arm of the incision can be carried upward, the flap raised to a corresponding extent from the left rectus muscle, and the median incision then extended upward through the deep structures.

*Miscellaneous.* A number of deaths following rectal extirpation are chargeable to iodoform poisioning from the use of iodoform gauze for drainage. Kraske experienced one case of death from torsion of the transverse colon due to the omentum's gliding upward under the liver and getting caught there, as a result of the high Trendelenburg position. He therefore stitches the omentum at the upper angle of the abdominal wound. Küpferle says the danger of peritonitis is much greater with the tamponade than with stitching the Douglas fold around the descended bowel. Czerny, Kocher, Mikulicz, Krönlein, Hochenegg, stitch the peritoneum, while Kraske regards it sufficient to simply close the opening with a tamponade (see above "Resectio recti by combined method.")

Czerny inserts traction threads into the cut edge of the peritoneal pouch through the abdominal wound, with the help of which he has no difficulty in closing the peritoneal opening through the posterior wound. Petermann says that Rotter begins on the second day after operation to change the tamponade and after three, or at latest, four days, the whole tamponade is renewed.

*The preparation of the patient.* In Rotter's clinic the patient is given castor oil on the third and second days before operation and light diet. On the morning preceding the operation enemas are given, and on this same morning as well as that of the operation the bowels are quieted with opium. Petermann says: "If one is to resect the bowel and employ the circular suture, he should not operate until he is sure the bowel is empty."

## THE LYMPHATICS OF THE ANUS AND RECTUM

In planning a wide removal of the tissues in operating for cancer of the rectum, a knowledge of the anatomy of the associated lymphatic structures is of prime importance. Quénu (111) made the first correct study of the lymphatics of the anus. Gerota (112) verified and amplified Quénu's work and added the anatomy of the lymphatics of the rectum. Poirier and Cunéo (with Marcille) (113) mention lymphatic trunks passing from the anus through the ischiorectal fossa and the levator ani to a pelvic gland, and have added the pelvic distribution of the efferents of the middle hæmorrhoidal lymphatic trunk. Morau (114) demonstrated anastomoses between the lymphatics of the vagina and rectum. From these several sources the following classification is made up. The anus here signifies the terminal portion of the intestinal tube below the upper limit of the internal sphincter. The rectum is the portion between the upper limit of the internal sphincter and the third sacral vertebra (Treves) (115). With the understanding that there exists a freely intercommunicating network of lymphatics lying in the mucosæ of the rectum and the anus and immediately beneath the marginal and perianal skin, it would seem simpler to make the classification apply solely to the collecting lymphatic *trunks* from the different territories.

1. Collecting trunks from the lymphatics of the cutaneous portion of the anus and perianal skin. (*a*) To inguinal glands (Quénu).

2. Collecting trunks from the lymphatics of the anal mucosa. (*a*) Middle hæmorrhoidal (Quénu). (*b*) To anorectal glands (Gerota). (*c*) Through ischiorectal fossa and levator ani to a pelvic gland—questionable constancy (Poirier and Cunéo).

3. Collecting trunks from the rectal mucosa. (*a*) To anorectal glands (Gerota). (*b*) Middle hæmorrhoidal (unconfirmed). (*c*) Vaginal (Morau).

*1. Collecting trunks from the lymphatics of the cutaneous portion of the anus and perianal skin.*

The cutaneous portion of the anus lies at the margin of the anal opening and consists of that portion below the white line which is covered by smooth, loose, pigmented skin devoid of hair follicles. Quénu showed that its lymphatics are continuous with the perianal network from which three to four collecting trunks on either side pass over the inner surfaces of the thighs to the glands of the groin. Quénu has classified the inguinal glands according to the quadrants—inner and outer, superior and inferior—in which they lie, radiating from the point of entrance of the internal saphenous vein into the femoral. Both Quénu and Gerota showed by injections of mercury into the lymphatics of the cutaneous portion of the anus or perianal skin, the greater frequency with which the collecting trunks from this region lead into the inner glands of both upper and lower inguinal groups. Gerota found that in more than half of his twenty-eight injected cases the collecting trunks lead to the inguinal glands of the upper and inner quadrant, in about a quarter of the cases to the glands of the lower and inner quadrant, and in the remainder to the glands of both upper and lower groups, thus demonstrating the probable frequency of invasion of the glands of the respective quadrants in malignant disease of the anal margin. The quicksilver injected beneath the skin of the anal margin likewise readily entered the lymphatics of the anal mucosa, which are disposed chiefly in the columns of Morgagni, and form the connecting chains between the lymphatic network at the anal margin and that of the rectal mucosa.

*2. Collecting trunks from the anal mucosa.*

(*a*) *Middle hæmorrhoidal trunks.* Quénu was the first to show that in some instances (three cases out of thirteen successful injections) quicksilver injected into the lymphatic network at the anal margin would diffuse through the lymphatics of the anal mucosa into those of the rectal mucosa, finally distending one or two lymphatic trunks which followed the course of the middle hæmorrhoidal blood-vessels. Quénu named these lymphatic trunks the *middle hæmorrhoidal*, and suggested, in his inability to demonstrate them constantly, the possibility of their being an anatomical anomaly. In this connection the writer would call attention to his observation on the inconstancy of the middle hæmorrhoidal blood-vessels (see under Fig. 12) in accordance with which it is not impossible that the middle hæmorrhoidal lymphatic trunks might also vary correspondingly. A possible absence of the middle hæmorrhoidal lymphatic trunks in some cases, with consequent lack of opportunity for lateral spread of the disease, might be one explanation of how a permanent cure can follow the excision of a cancerous rectum by the sacral route, in which the laterally entering structures from the pelvic wall have been tied and severed close to the rectum (Figs. 11 and 12, *hook* 1).

Gerota agreed with Quénu on the infrequency of the middle hæmorrhoidal lymphatic trunks, he having

succeeded in injecting them only twice in twenty cases. Poirier and Cunéo, however, state that Marcille, using Gerota's method, was able to demonstrate the middle hæmorrhoidal lymphatic channel in nearly every case and that they, therefore, regarded it as constant.

*The termination of the middle hæmorrhoidal lymphatic trunks* in two of Quénu's cases was in a gland located at the pelvic wall at a site of branching of the blood-vessels. In the third case the quicksilver did not carry through the entire course of the lymphatic trunk. Gerota found in one of his cases that this lymphatic trunk followed the upper surface of the levator ani and terminated in a gland at the pelvic wall, and in the other case it followed the course of the middle hæmorrhoidal vessels and terminated in a gland situated close to the rectal wall at the point where the middle hæmorrhoidal artery gave off the vaginal branch. Poirier and Cunéo describe the usual termination of the middle hæmorrhoidal lymphatic trunk as being in a gland on the middle hæmorrhoidal artery at some distance from the pelvic wall, whence efferent branches proceed, one along the vessels to a gland at the pelvic wall, one to the middle gland of the internal chain of the external iliac group, and one to a lateral sacral gland. Or the main lymphatic trunk may pursue an aberrant course and terminate directly in either one of the latter glands. These anatomical facts strongly suggest the necessity for wide enucleation of a cancerous anus or lower rectum at the pelvic wall with the removal of the lateral sacral glands, those in relation with the branches of distribution of the internal iliac vessels, and the mass of loose lymphatic tissue which lies along the external iliac vessels and the obturator nerve (see text Fig. 34), which alone can be accomplished by entrance to the seat of disease from above through an abdominal wound.

(*b*) *To anorectal glands.* Gerota found that by injecting the lymphatics of the cutaneous portion of the anus, the quicksilver after infiltrating the anal mucosa not only occasionally proceeded into middle hæmorrhoidal trunks, but constantly entered lymphatic trunks which, following the superior hæmorrhoidal blood-vessels, passed through the muscularis of the rectal wall and emptied into the glands lying in the cellular tissue between the muscularis and the fascia propria recti. These glands receive lymphatic trunks as well from the mucosa of the rectum, so that Gerota has called them *anorectal glands.* The lymphatic trunks from both anal and rectal mucosæ, which follow the branches of the superior hæmorrhoidal blood-vessels he called the *superior hæmorrhoidal lymphatic trunks.*

*The anorectal glands* are two to eight in number on each side, and are situated laterally upon the muscular wall of the rectum up to its upper part where they converge posteriorly toward the pelvic mesocolon. These glands with their associated lymphatic tissue can be anatomically isolated from their posterior connections in conjunction with the bowel by virtue of their relation to the fascia propria recti (see text Fig. 4) which is interposed between them and the posterior wall of the pelvic cavity. Thus, in the upper part of the pelvic cavity the lymphatics and associated superior hæmorrhoidal vessels connected with the posterior aspect of the bowel, can be readily freed behind by raising them forward from off the anterior surface of the fascia propria recti (pelvic retrointestinal plane of cleavage, Figs. 25 and 33), while in the lower part of the pelvic cavity the bowel and associated lymphatic and vascular structures are best freed posteriorly by carrying the cleavage behind the fascia propria recti (Fig. 9), an opening (Fig. 33 *cd*) being made in the fascia between the upper and lower areas of cleavage to enable the dissection behind the bowel to be made in continuity. In view of the upward coursing of the superior hæmorrhoidal lymphatic trunks longitudinally along the bowel, the necessity for a high section of the bowel in low situated cancer would seem as important as the need for a wide enucleation at the pelvic wall. Moynihan has recently called attention to a gland situated at the origin from the aorta of the inferior mesenteric artery, it being the highest one of the chain running upward from along the superior hæmorrhoidal vessels, the removal of which together with the lymphatic tissue below he recommends in cases both of high and of low cancer of the rectum and of cancer of the sigmoid. (See p. 132.)

(*c*) *Through ischiorectal fossa and levator ani to a pelvic gland.* Poirier and Cunéo describe lymphatic trunks — which one of them and Marcille have injected a number of times — emerging from the anus beneath the insertion of the levator ani, then usually running a short distance in the fat of the ischiorectal fossa to perforate the levator ani, and terminating in a gland at the origin of the internal pudic artery. The course thus does not follow the inferior hæmorrhoidal vessels. From their present observations, Poirier and Cunéo cannot affirm the constancy of these trunks. Quénu states: "We have not seen in our best injections any lymphatics coming from the anus and following the internal pudic vessels." Thus in cancer of the anus great, if any, invasion of the ischiorectal fossæ would not be expected.

*3. Collecting trunks from the rectal mucosa.*

(*a*) *To anorectal glands.* Gerota found that these lymphatic trunks arose in the rectal mucosa, passed through the muscularis at different levels following branches of the superior hæmorrhoidal vessels and terminated in the anorectal glands. As already stated, these trunks, together with those from the mucosa of the anus, which likewise follow branches of the superior hæmorrhoidal blood-vessels, Gerota called the *superior hæmorrhoidal lymphatic trunks.*

(*b*) *Question of middle hæmorrhoidal lymphatic trunks communicating with rectum.* Gerota thus differentiated trunks from the anal mucosa and trunks from the rectal mucosa, both going to the anorectal glands, but the inconstant middle hæmorrhoidal trunks, being discoverable only through injections of the anal mucosa, are mentioned as positively draining only the lymphatics of the anal mucosa. Gerota states that the lymphatics of the rectal mucosa are difficult of injection on account of their fineness, and more difficult is the injection of the trunks which these vessels form,

it seeming to be impossible to get the mercury to pass freely through the muscular coat of the rectum. He was absolutely unable to inject the muscular coats of the human rectum but he twice easily accomplished it in dogs, discovering in them lymphatic trunks passing over the side surfaces of the rectum and finally emptying into glands at the pelvic wall at the level of the sacroiliac articulation. These might be regarded as comparable with middle hæmorrhoidal trunks in the human being. Hence, judging from such an analogy, and considering the freedom of anastomosis between the lymphatics of the anal and rectal mucosæ, and the high point of departure from the rectal wall which the middle hæmorrhoidal lymphatic trunk usually takes in company with the middle hæmorrhoidal vessels at about the level of the cul-de-sac, one can entertain at least a reasonable supposition that these middle hæmorrhoidal lymphatic trunks must collect lymph, too, from the rectal as well as from the anal mucosa and consequently be just as liable to invasion in high rectal as in low rectal or anal cancer. Corroboratory of such supposition is the fact of the invasion of the tissue tied lateral to the cul-de-sac in the case here reported, which was one of cancer involving the middle and upper portions of the rectum.

(*c*) *Question of vaginal lymphatics communicating with rectum.* Morau (116) claims that mercury injected into the lymphatics of the vaginal wall, preferably its posterior surface, constantly demonstrated two median lymphatic trunks lying in the rectovaginal septum, and that, furthermore, by a special technique the mercury would infiltrate the whole anterior wall of the rectum in direct relation with the vagina, thereby demonstrating a direct continuity between the two systems. Poirier and Cunéo concede a communication between the lymphatics of the rectum and those of the vagina, but Gerota says he has never observed any lymphatic vessels going from the rectum to the vagina. Nevertheless, it is an actual fact that the vaginal wall and the rectouterine fold may become invaded in cancer of the rectum, as was evidently the case in the patient here reported. Add to this the liabilty of invasion through the middle hæmorrhoidal lymphatic trunks, of the parametrium which is so closely blended with the so-called paraproctium that no anatomical differentiation between the two can be made, and there would seem to be quite sufficient reason to regard the removal of the rectum, uterus, and adjoining part of the vagina, together with all laterally associated cellular tissue out to the pelvic wall, in one mass, the surest method of procedure.

*Lymphatic anastomosis.* Krömer (117) observed in studying the parametrium, that the vasa afferentia before entering the glands regularly gave off branches to neighboring glands or their afferent or efferent trunks. Such free lymphatic communication, favoring a wide dissemination of disease products, would point to the necessity for a wide removal of lymphatic tissues in cancerous disease.

### THE URETERS

*Frequency of invasion.* There is little in literature regarding the invasion of the ureter in cancer of the rectum, and when mentioned it is usually figured in connection with autopsy findings, since the condition of the ureter has not been made an object of study in operating for the removal of a rectum which is the seat of malignant disease. Quénu and Hartmann (118) mention the reported autopsy findings in several cases, showing involvement of the ureter both with and without obstruction of its lumen. In the absence of definite knowledge as to the frequency of invasion of the ureter in cancer of the rectum, it would seem a matter of interest anyway, in this connection, to consider what is known of the condition of the ureter in cancer of the cervix uteri. Mackenrodt (119) collected about 600 cases of abdominal total extirpations for cancer of the uterus, of which only four or five had ureteral invasion. He states: "The ureter, even when surrounded by a mass of cancerous infiltration, still is itself invaded only in the rarest cases." Pankow (120), from his pathological studies, likewise concludes: "The ureter has a certain resistance to the invasion of carcinoma. It rarely itself becomes carcinomatous, even if the carcinoma grows close to it." A comparison of the lymphatic channels which drain the cervix and the rectum laterally, shows that those from the cervix pass directly out to in front of and behind the ureter, while those from the rectum (middle hæmorrhoidal trunks) course more deeply in the pelvic cavity, so that it would seem probable that in cancer of the former region invasion of the ureter would be more liable of occurrence than in cancer of the latter, or anyway no more liable in cancer of the rectum than in cancer of the cervix. In the discoverable literature relating to involvement of the ureter in uterine cancer, the question of the frequency of invasion of the ureteral sheath, which is Sampson's indication for resection of the ureter, was not found to have been considered.

*Arterial supply and necrosis.* Sampson (121) has investigated the blood supply of the ureters with a view of determining the conditions under which necrosis is liable to occur. His investigations, the results of which are very conclusive, can be summarized as follows: There are two main arterial trunks, one on either side of the ureter and loosely connected to it,

which give off smaller branches to the ureter anastomosing with each other to form a plexus. In four injected specimens this periureteral arterial plexus in its pelvic portion received branches constantly from the internal iliac and uterine arteries, and inconstantly from the vaginal and middle vesical. Sampson has shown that in ureters of dogs, isolated their entire lengths, some of the larger branches of the ureteral plexus could be destroyed without necrosis necessarily occurring, yet in a segment of ureter exposed but a short distance, if the smaller branches are destroyed, as would be done by scraping with a sharp knife, then necrosis will occur. He emphasizes the danger of interfering with the blood supply of the ureter as a result of stripping disease tissues from it, particularly if the arteries entering this area of the ureter are tied. Cases have been reported in man where the ureter has been dissected free for its entire length and no necrosis has occurred. This was because the integrity of the periureteral arterial plexus was maintained and through it the independent ureteral circulation took place from the renal artery to the bladder. Sampson calls attention to the fact that, though the ureter may be dissected free with impunity, there is, nevertheless, a danger, in doing it, of injury to the plexus which might result in sloughing of the wall. In another article Sampson (122) emphasizes the importance of preserving the fibrous sheath of the ureter, primarily to avoid the danger of injury to the periureteral arterial plexus which lies within it, and secondarily to avoid stricture of the ureter which would likely result after depriving the latter of this covering in which it can contract, from the formation of cicatricial tissue directly around it. He, therefore, recommends, when the ureteral sheath is not involved in cancer of the uterus, the dissecting free of the ureter with its sheath intact. Sampson makes the involvement of the sheath in the disease the determining point in favor of resection of the ureter rather than to take the chance in such cases of ureteral necrosis that might follow splitting the sheath and shelling the ureter out, which he says can be done. The absolute diagnosis of the invasion of the ureteral sheath, however, can sometimes be made only with the microscope.

*Manipulation of the ureters.* Analogies can be deduced from the methods of handling the ureters in cancer of the cervix, to apply to the manipulation of the ureters in wide excision of the rectum. Sampson probably inculcated the correct principle applicable to freeing the ureter in the pelvis without endangering its vitality, when he recommended the *dissecting free of the ureter with its sheath intact.* If the parametrium be cut mesial to the ureter, the latter, left suspended in a fascial layer attached above along the external iliac vessels, can thus be hooked upward and the obturator glands and fat readily peeled out from beneath, but the glands along the external iliac vessels cannot be reached through this approach. The writer has shown (Fig. 34) how the ureter, not only in company with its protecting sheath, but also with its arterial supply from the uterine artery, can all be freed together so as to hang in the pelvis in one well-vascularized loop. The dissection at the pelvic wall, of the obturator glands and those along the external iliac vessels, can then be readily made. The region of the bifurcation of the common iliac artery is bared for exploration by raising from it the ureter in its sheath attached to the peritoneum. von Rosthorn (123) states, regarding the operation for cancer of the cervix uteri: "We do not peel off the ureters in this extensive operation, from the sheath, as was formerly done, because we have had necrosis and fistula in several cases." And again (124): "We have made it a principle to allow the ureter to remain in connection with the posterior layer of the broad ligament and to denude it as little as possible from its enveloping cellular tissue. Whereas, when the ureter passes directly through the cancerous mass, it is better to resect it entirely and implant it in the bladder." Wertheim (125), through an incision in the posterior layer of the broad ligament, first exposes the ureter, and then passes his finger along the latter through the parametrium as far as to the bladder, raising from the ureter the fascial layer in which the uterine artery lies. The artery is tied and the raised fascial layer is severed, exposing the ureter beneath. Wertheim has recorded experiences illustrating the difference between rough and careful handling of the ureters. In an early

series of thirty cases the ureter was stripped freely out of its bed, with a resulting five cases of ureteral fistula, but in the next series of thirty cases in which Feitel's (126) proposition to dissect out, tie, and cut the branches of the uterine artery to the ureter was employed, instead of tearing them loose, only two fistulæ developed, and they occurred in invaded cases where the ureters really ought to have been resected. In a recent publication Wertheim (127) states, regarding the treatment of the ureters; "It is important when freeing the ureters, to avoid, as far as possible, completely raising them and injuring the ureterovaginal vascular network." And again: "If the ureter is fixed . . . . by careful dissection one can separate even firmly fixed ureters from the tumor without any danger to them." Ries (128) approaches the ureter early in the operation through an incision to reach the external iliac glands. He says: "This has the advantage that with the removal of the glands one finds without difficulty the ureter which can then be kept constantly in view during the further removal of the pelvic connective tissue." Ries (129) does not consider it important to preserve the sheath of the ureter. Regarding this question he has said: "Where I have dissected out the ureter in the pelvis I have not respected the sheath of the ureter. I have laid bare the ureter completely up to a point where it crosses the iliac vessels. I have had only one ureteral fistula, and that closed spontaneously." Mackenrodt (130), similarly to Ries, exposes the ureter by separating the parametrium inward from the pelvic wall, then he splits over the course of the ureter and raises the latter with blunt force. He advises that, before resection of a ureter be decided upon, the ureter should always be first laid bare for examination. He regards the operation of resection and implantation in the bladder as difficult and dangerous. Bumm (131) likewise approaches the ureters and external iliac glands together at the pelvic wall, and from this aspect "lays the ureters free up to their entrance into the bladder."

Resection of the portion of the ureter lying within the parametrium with implantation of the proximal end into the bladder, would seem to be indicated in the presence of a sufficient invasion around the ureter. Sampson's indication to resect the ureter when its sheath has become invaded by carcinoma seems a good, general working principle, in accord with the idea of a wide removal of the disease. In implantation of the ureter into the bladder Sampson preserves the ureteral sheath, excepting around the extermity of the ureter which is passed into the bladder. To relieve tension he raises the ureter with its sheath and the attached peritoneum from its bed, and then sews the sheath and the peritoneal flap to the bladder-wall around the implanted extremity. Mackenrodt to diminish tension sews the bladder laterally to the pelvic wall after the method of Witzel and Fritsch. von Rosthorn (132) in several cases ligated one ureter which was involved in the cancerous process, when the kidney and ureter of the other side were in good working order, in patients where the operation had already lasted two hours and the taking of the additional time to make a bladder implantation of the resected ureter would have been decidedly unfavorable to the patient's welfare. The simple ligation of one ureter renders the kidney of that side atrophic, and, in the presence of good function on the other side, is attended with no disadvantage to the patient. (For particulars see von Rosthorn, Verhandl. der Deutschen Gesellschaft f. Gyn., Bd. XI). von Rosthorn has seen no bad results from the ligature of one ureter but would not, however, recommend it as a regular procedure.

### THE BLADDER

*Frequency of invasion of.* In rectal cancer this would relate chiefly to the male. In cancer of the cervix, Pankow says; "The bladder wall becomes carcinomatous late. There may be an œdema bullosum."

*Effect of operation on innervation.* von Rosthorn's (133) reference to experimental work on this subject is of interest: "We have found that resection of the nerves of the bladder in animals does not interfere with the function of the bladder. We have separated the bladder down to the urethra and all its nerve fibers and ganglia, and we have not seen the slightest disturbance of function in animals." It is the usual experience that the bladder is temporarily paralyzed after rectum extirpation.

In Czerny's cases catheterization was necessary seldom for longer than 10 days. Twice voluntary urination was delayed 10 weeks, and once four months, probably from injury to the detrusor muscle.

SURGICAL ANATOMY

The illustrations 1 to 34 are drawings made directly on photographs of the dissections; 35 is a tracing from a photograph; and 36 to 38 are free-hand sketches. The anatomical planes of cleavage have been particularly worked out with a view of establishing a systematic method of isolating the various structures under manipulation. The studies illustrate surgical anatomy relating to excision of the rectum for cancer situated well above the pelvic floor in the female from *four* different standpoints. *The writer would emphasize the fourth proposition as presenting the most promising possibilities toward establishing a correct technique.* The four operative propositions are differentiated as follows:

I. *Close local excision of the rectum alone* above the pelvic floor, by the *posterior route*, or by the *combined* posterior and abdominal *routes* (Figs. 1 to 14 and Fig. 25), the latter being the operation performed on the case here reported.

II. *Wide local excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor by the *combined* posterior and abdominal *routes* (Figs. 1 to 9, 12, and 15 to 27).

III. *Wide local excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor, entirely by the *abdominal route* (Figs. 28 to 32).

IV. *Wide radical excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor, with *removal of the regional glands*, entirely by the *abdominal route* (Figs. 33 and 34).

The illustrations of wide local excision, which represent the preliminary anatomical work which lead up to the later conclusions, have all been produced here since each one demonstrates some instructive anatomical phase, yet the fourth proposition of wide radical excision by the abdominal route with removal of the regionary glands would seem, from its greater thoroughness, to be preëminently the operation of choice. The illustrations include a *method of exposure of the parametrial portion of the ureter in its sheath* (Figs. 18 to 21), and one of *freeing the ureter in its sheath from the parametrium* (Figs. 33 and 34) for the purpose of gaining access to the external iliac glands; also the demonstration of a proposition for the *freeing of the sigmoid flexure* with the least possible amount of injury to its vascular supply (Figs. 25, 27, and 30), and a *retrorectal approach* (Figs. 36 to 38).

I. *Close local excision of the rectum alone*, above the pelvic floor, by the *posterior route*, or by the *combined* posterior and abdominal *routes* (Figs. 1 to 14 and Fig. 25), which latter was the operation performed on the case here reported.

The figures of series I serve to illustrate anatomically how the rectum can be freed from its attachments close to its wall, and, together with its posterior lymphatic associations, raised out of its bed preliminary to excision, which technique corresponds to what must be the total accomplishment in all the operations performed entirely through the sacral and perineal approaches. The anatomy of this operative procedure was illustrated for two reasons, first, for the sake of clearly establishing the operative steps, and, second, for the purpose of comparing the amount of lymphatic tissue removed by this operation in which the laterally entering vessels and nerves are tied and severed close to the rectum, with that removed by an operation contemplating the excision of the rectum, uterus, and part of the vagina, *en masse*, in which the laterally entering nerves and vessels are severed close to the pelvic wall. As has been noted, the lymphatic tissues draining the rectum and vagina laterally are so closely associated, lying in one mass, that if the removal of any part of this structure beyond the rectal wall is contemplated, then the whole mass must be taken together and the corresponding portion of the vagina removed with the rectum. The surgical correctness of a proposition to remove the lymphatics draining the rectum laterally, in addition to those draining it posteriorly, is exemplified by the pathological findings in this reported case. The horseshoe flap was employed in the dissections for approaching the rectum from behind, in

order to afford a better exposition of the underlying anatomy, though for operative technique the writer would suggest the use of the Kraske or the Hochenegg retrorectal approach or of the proposed approach illustrated in Figs. 36, 37, and 38, as preferable. (See "Choice of retrorectal approach," p. 224.) Fig. 9, on the left side of the dissected specimen, includes for comparison a view of the tissue (L S) containing the arteries and nerves of the parametrium which enter the rectum and vagina laterally, isolated in one mass close to the pelvic wall where they can be tied in the proposed operation for wide local excision of the rectum, uterus, and part of the vagina together. Fig. 25 shows the position within the peritoneal cavity of the grooved director in Fig. 13.

Fig. 1. A horseshoe incision is made, its extremities at the posterior margins of the tuberosities of the ischia and its summit arching across the lower part of the sacrum a little above the sacrococcygeal joint. The incision is carried down to the glutei maximi muscles, the fibers of which are then followed downward with the knife as the flap is raised. When the lower borders of these muscles are reached, the fascia raised from their surfaces is cut through (*a b*) close to the muscle fibers for about two or three inches on either side of the tip of the coccyx, thus reaching the ischiorectal fat, which is then incised along the muscle borders to a depth of about half an inch or more, until the smooth anal fascia of the two sides can be felt by the finger in the bottom of the wound. The finger then follows the latter fascia to the median line, raising from it by blunt separation the overlying fat. At the median line the anal fascia on either side is reflected onto the posterior fibers of the external sphincter, forming a double fold which can be felt between the thumb and finger as a median septum above the external sphincter, between the latter and the levatores ani. The interval between these muscles is torn or cut through. The posterior portion of the external sphincter thus isolated (*hook* encircles it) is made taut, its attachment to the coccyx severed, and, together with the skin flap in which it lies, is turned downward.

Fig. 2. The mode of juncture of the two levatores ani posteriorly is by the coming together of two distinct layers into which the muscle of either side divides at this situation. The more superficial layer consists either of muscle fibers looped from side to side (the condition usually found) (sup. L A, Fig. 14), merging below with the sling of muscle known as the puborectalis (Fig. 3) — described by Harris (135) and likewise illustrated by the writer (136) — which arises from the pubic bone on either side and passes around behind the anus above the posterior fibers of the external sphincter, or, as in this dissection, this layer consists of a thin fascia (sup. L A, raised on director), which merges with the muscular sling below. The deeper layer of junction of the posterior fibers of the levatores ani beneath consists mesially of firm, shiny, aponeurotic tissue (Fig. 3 *h*) which serves as a guide in finding the plane of separation between the two layers. The dissection here shown was the only one in which the writer has found the superficial layer to consist of the thin fascia. The plane of separation between the two layers is best reached by cutting directly down upon the tissues in the median line below the tip of the coccyx, after the horseshoe flap with the sphincter has been reflected, until the aponeurotic structure of the deeper layer is met. The latter is then followed downward with the scalpel handle which below peels backward the puborectalis muscle from the aponeurotic insertion (Fig. 3 *i*) of the levator ani into the anus. The mode of this insertion of the levator ani is by its juncture with the terminal fibers of the longitudinal coat of the bowel and the termination of the rectovesical fascia, and the continuation downward of these combined structures as an aponeurosis between the external and internal sphincters. The situation is shown of the inferior hæmorrhoidal vessels and nerves which are not injured by any step of the operation. The presence of a branch from the fourth sacral nerve to the posterior fibers of the external sphincter, in the observation of the writer, is of rare occurrence.

Fig. 3. The superficial layer of junction of the posterior fibers of the levatores ani (*j g, j g,* cut edges) has been split open down to the puborectalis muscle, the latter has been peeled backward, and the coccyx is in course of excision. The median aponeurotic structure of the

deeper layer of junction of the posterior fibers of the levatores ani (deep L A) is shown up, as well as the mode of termination of this layer below in aponeurotic fibers (*i*) passing into the anus between the external and internal sphincters. The coccyx is easily excised by first partially dividing the attachments of the gluteus maximus and coccygeus muscles on either side of it, and then, after finding the joints of the articular processes, opening into them as well as cutting through the cartilage between the coccyx and the tip of the sacrum by an incision directed straight forward with relation to the long axis of the body, or at an oblique angle to the posterior arm of a line tangent to the curve of the sacrum at the point of disarticulation. One upper angle of the coccyx is now easily raised and held taut by an artery forceps clamped to the soft tissues on the back of the bone, and the bone is readily dissected out of its bed by hugging its deep surface with a knife. The floor of the space from which the coccyx was removed consists of an aponeurotic structure continuous below with the structure of the levatores ani, and laterally with that of the coccygei muscles. In it lie the terminations of the sacral vessels. (Fig 36.)

Fig. 4. A longitudinal incision is made in the floor of the space from which the coccyx was removed a little to one side of the median line, exposing beneath a smooth, shiny layer of fascia, which is a part of the rectal sheath (fascia propria recti of Waldeyer) described at the end of the consideration of this figure. When this fascia is reached the finger is introduced through the incision, and enters a fascial compartment between the rectal sheath and the rectovesical fascia covering the upper surface of the levator ani, which it easily opens up by blunt force. This compartment is limited above by the firm attachment of the rectal sheath along the upper border of the lesser sacrosciatic ligament (Fig. 8 *m x*), in front by the fascial attachment of the rectal sheath to the fascia covering the levator ani (Fig. 8 *x n*), and behind by the delicate fascial attachment of the sheath to the front of the sacrum in a line from the fourth sacral foramen to the tip of the sacrum (Figs, 6 and 8 V F), and by the median septum between the compartments of the two sides (Figs. 5 and 8 M S). The corresponding spaces on the two sides from their situation can be called the *posterolateral rectal spaces*. When the one space has been opened up by the finger, the primary incision is enlarged downward (course of *director*) through the fibers of the levator ani just to one side of the median line. These spaces in the illustration were opened up by two incisions, one on either side of the median line, leaving between them a narrow bridge of aponeurotic tissue remaining attached by the median septum (Fig. 5 M S) to the fibrous sheath of the rectum. It can be interpolated here that a better *operative method of opening these spaces* is, after having opened one side as indicated in the figure, instead of making the parallel incision through the other levator ani, to open the space of the second side by a transverse incision a little below the tip of the sacrum, joining the primary incision, and then a division of the median septum between the compartments. In this way there is no loss of substance of the levatores ani, and, if desired for any reason, as in an operation for prolapse, a good closure of the wound can be effected. Care should be taken not to cut the levator ani below the lower limit of the posterolateral compartment, since below this level this muscle becomes adherent to the bowel and by careless cutting into a fold of tissue at this situation the bowel could easily be entered, as happened in one dissection on the cadaver.

*The fascia propria recti* (Waldeyer's nomenclature). This fascia below the site of attachment of the tissues L R (Figs. 10 and 11) containing the vascular and nervous structures (Fig. 12) entering the rectal wall laterally, which site is a little above the level of the bottom of the cul-de-sac, sheaths the rectum behind and laterally, extending as far forward as the side walls of the vagina to which it is attached. This lower portion, therefore, literally forms a sheath for the rectum. Above the site of attachment of the tissues L R the fascia propria recti (see "Surgical Importance of" this portion, text Fig. 25) is in relation with the bowel only posteriorly, thence extending laterally beneath the peritoneum over the pelvic wall. It can thus be seen that the fascia propria recti above the cul-de-sac, spreading laterally from behind

the bowel rather forms in this situation a covering of the pelvic wall than a sheath for the bowel. Generally corresponding to its extent above the tip of the sacrum (Fig. 33), or occasionally only above the level of the third sacral vertebra (Fig. 25), this layer can be stripped entirely back from the vascular and lymphatic structures (V B L) connected with the posterior aspect of the bowel and from the peritoneum extending out from the bowel on either side, so that in this situation a plane of cleavage can be opened up between these layers, here denominated the pelvic retrointestinal plane of cleavage (see text Fig. 25) which is recommended for employment in excision of the rectum by the abdominal route. Fig. 33 shows through this opened-up plane of cleavage the extent laterally of the fascia propria recti, at the brim joining the ureteral sheath (see also Fig. 30), lower reflected forward to form the posterior fascial covering (*g*) of the ureteral compartment (See text Fig. 19) of the parametrium, and at its lowest seat of reflection covering the tissues (L S) containing the arteries and nerves entering the rectum and vagina laterally from the pelvic wall. In an upward direction this fascia extends over the lumbar vertebræ. It is a carrier of sympathetic nerves (Figs. 25, 28, 31). By its parietal surface the fascia propria recti has certain attachments (Fig. 8 *l m x n*, V F, and M S) to the pelvic wall and floor, subdividing the area between it and the parieties into spaces — retrorectal (Rr S Figs. 6, 7, and 33), sacrosciatic (Ss S Figs. 9, 32, and 33), and posterolateral rectal (P L R S, Figs. 4, 5, and 6). A knowledge of these parietal attachments and extrafascial spaces is important in excising the rectum. By the posterior route they are approached directly. By the abdominal route they are approached through the pelvic retrointestinal plane of cleavage (See text Fig. 33).

Fig. 5. The median aponeurotic structure in the floor of the space from which the coccyx was removed has been cut across, and the finger, introduced above it and caused to make moderate pressure at the tip of the sacrum up along the anterior surface of this bone, easily opens up the space between the bodies of the sacral vertebræ and the fascia propria recti, known as the *retrorectal* space (Figs. 6, 7, 25, 26, and 33, Rr S). This space is limited on either side by the lateral attachments *l m l′m′* Fig. 7 of the fascia propria recti to the sacrum, and below by the V-shaped folds (V F) attached to the sacrum, while in an upward direction it extends in front of the promontory and the bodies of the lumbar vertebræ. After having opened the retrorectal space with the finger, a knife handle was introduced into it for illustration.

Fig. 6. The lower extremity of the sacrum having been sawn longitudinally in the median line up to a level just below the inferior lateral sacral angles, which is inferior to the lower bony margins of the fourth sacral foramina, the bone was then divided transversely with an osteotome at the upper limit of the saw cut and the fragment thus freed on either side (Frgt 1, Frgt 1,) reflected outward. This corresponds to the level of transverse division of the sacrum in Fig. 38.

Above the level of this transverse division of the lower end of the sacrum a mesial section of bone was removed from the sacrum to show up the retrorectal space into which the knife handle in the previous illustration was introduced. A second fragment (Frgt 2) on either side was then broken off opposite the fourth sacral foramen. Traction on the puscia propria recti at a point corresponding to where it lay against the tip of the sacrum, brings out two folds which diverge from the point of traction in the shape of a V, each arm of which ends in a dense fibrous cord (*m*, *m′*) connected to the front of the sacrum at the inner margin of the fourth sacral foramen. These folds correspond to the lines of delicate fascial attachment, which are easily torn away from the sacrum up to the fourth sacral foramina by the finger entering here the retrorectal space. The fibrous cords limit upward separation of the V-shaped line of attachment. They have a firm connection with the rectal sheath, affording it a strong support in this situation, and must therefore be cut in order to draw the bowel downward.

Fig. 7. The left side of the sacrum has been sectioned through the second sacral vertebra and the portion which is freed has been drawn outward so as to show in continuity the *posterolateral attachments* (*l m x n*) *of the fascia propria*

*recti to the pelvic wall and floor.* These attachments (see also Figs. 8 and 9), on either side, lie in a line broken into three parts by two angular turns. The latter are at the fourth sacral foramen corresponding to the fibrous cord (*m*) which passes into the V-shaped fold, and at the spine of the ischium over which an *x* is placed in the illustration. At the former point a line of vertical fascial attachment (*l m*, *lateral sacral attachment*) to the front of the sacrum along the inner margins of the foramina, joins with a line of horizontal attachment (*m x*) along the upper border of the lesser sacrosciatic ligament. At the spine of the ischium the line of attachment *m x* joins with that *x n* securing the fascia propria recti to the fascia covering the upper surface of the levator ani (cf. Fig. 9). The latter line of attachment takes a downward direction from the spine of the ischium, terminating at a posterolateral point on the periphery of the bowel at the level of its junction with the levator ani, and corresponds to the sulcus at the forward limit of the posterolateral rectal space. This line (*x n*) is found to immediately overlie the posterior portion of the attachment of the lower border of the parametrium (see p. 192) to the white line, forming the floor of the vesicoparametrio-pelvic space, (see text, Fig. 34), so that these two attachments where they lie apposed, together form a double partition (Fig. 16 *x'r* and *w a*), separating the posterolateral rectal and vesicoparametriopelvic spaces. In breaking down this partition in operative work, the double attachment appears as a single one and the layers are not differentiated. *op* is the line of incision in the fascia a little below and external to the fibrous cord *m*, through which an entering instrument (Fig. 8) can separate out the fibrous attachments of the fascia propria recti to the sacrum (*l m*) and to the lesser sacrosciatic ligament (*m x*).

Fig. 8. The line *l m x n* of parietal attachmen of the fascia propria recti, which is divided in the proposed operation of wide local excision of the rectum together with the uterus and part of the vagina, is here shown in comparison with the line *l' m' q r*, which is that of cutting the fascia in close local excision of the rectum alone (See Fig. 10 and text Fig. 9). The chief difference is that *q r* is a little more posterior than *x n*, and through it the rectal sheath is entered, while separation along *x n* is at the pelvic wall and passes outside of the rectal sheath. This difference is well shown in Fig. 15. A knife handle has been introduced through the opening *op* and has entered a plane of cleavage just external to the lateral sacral fascial attachment (*l m*) of the fascia propria recti. The finger entered here can be made to pass out laterally over the smooth surface of the pelvic fascia covering the pyriformis muscle and the sacral nerves, and binding in place the posterior divisions of the internal iliac vessels and their branches (Fig. 32), at the same time separating forward in its course the covering of peritoneum passing out from the side of the bowel, together with the fascia propria recti (see text Fig. 4) beneath it extending laterally from behind the bowel. This plane of cleavage when opened up is here denominated from its location over the great sacrosciatic notch, the *sacrosciatic space* (Figs. 9, 32, and 33 Ss S). All of the lateral sacral attachment (*l m*) of the fascia propria recti, excepting the stout fibrous cord (*m*) forming its lower extremity, and the upper portion attached to the body of the first sacral vertebra (Fig. 26), which is likewise thickened, has generally a delicate structure which can be readily torn through by the finger (see exception Fig. 30 C), exerting pressure from within the retrorectal space outward. Hence the sacrosciatic space can be readily entered by tearing through the delicate portion of *l m* from within the retrorectal space, which is the proper operative method of approach to this space both by the posterior and the abdominal (Fig. 33 to Ss S) routes. Entering the sacrosciatic space by this approach, the finger hooked downward encounters the lower portion of the parametrial attachment (see text Fig. 12) to the pelvic wall containing the arteries and nerves (Figs. 9 and 33 L S) entering the rectum and vagina laterally from the side wall of the pelvis, and pressed forward its progress is arrested by the line of attachment of the fascia propria recti along the ureter and parametrium, both of which sites of limitation mark boundaries of the space. The fibrous cord *m* is hooked up with the finger and cut. The *hook* in the illustration loops up the fascia

attached along the upper border of the lesser sacrosciatic ligament, which may tear through with pressure, or may have to be cut. The cross *x* indicates the situation of the *spine of the ischium* which can be readily felt through the fascia and is a *very important guide.* It indicates the site for entering the vesicoparametrio-pelvic space by blunt force, a necessary preliminary to accomplish easily detachment of the fascia propria recti and parametrium along the line *x n* (see text Fig. 7), and is also the guide in locating at the pelvic wall the vaginal and middle hæmorrhoidal vessels both in the operation from below (see text Fig. 15) and in that from above (see text Fig. 32).

*Entrance to the vesicoparametrio-pelvic space* from the posterolateral rectal space by penetration through the fascial attachments (cf. Fig. 16 *x' r* and *w a*), along the line *x n* can be very readily effected with the proper technique, without which the effort to sever these attachments might become a bungling procedure. The guide for effecting entrance to this space is the spine of the ischium against which firm forward pressure with the finger should be made, sometimes it being necessary to first cut through the fascial attachment (*m x* Fig. 8) along the lesser sacrosciatic ligament. The tissues yield and the finger glides into the vesicoparametriopelvic space along the smooth fascia of the pelvic wall just below the line of attachment to the pelivc wall of the parametrial tissue (L S) containing the arteries and nerves entering the rectum and vagina laterally. When the space is once entered as described, downward pressure with the finger will then tear both of the lines of fascial attachment, together separating the spaces, away from the parieties down to the site of juncture of the levator ani with the anus, thereby throwing the two spaces into one (Fig. 9). Unless the spine of the ischium is here taken as the guide, difficulty may be experienced in entering this area, since the attachment of the fascia propria recti along the line *x n* below the spine of the ischium, is very narrow and practically impossible to define with precision for cutting, and being of considerable firmness one cannot readily force a direct passage through it by pressure from behind.

Fig. 9. On the left side of the dissection, the entire line (*l m x n* Fig. 8) of the posterolateral fascial connections of the fascia propria recti to the pelvic wall has been detached and the attachment of the parametrium to the white line (Fig. 16 *w a*) which underlies *x n* torn through, thus opening up the sacrosciatic (Ss S) (see text Fig. 8) and vesicoparametriopelvic (Vp-P S) (see text Figs. 8 and 34) spaces, between which latter there is exposed to view the mass of tissue L S which attaches the rectum and vagina laterally to the pelvic wall. This tissue (L S) is the base of the line of attachment of the parametrium (see p. 192) to the pelvic wall along the course of the entering vessels and nerves. In the lower part of it are found the nerve structures, while at about the level of the spine of the ischium is felt the middle hæmorrhoidal artery, if present, and just a little higher the vaginal artery (see Fig. 12). A hook has been passed close to the pelvic wall around the tissue L S containing these laterally entering structures, a method of isolating which for ligature is described under Fig. 15. The parts on the left side are brought as prominently as possible into view by traction on the bowel to the right. The separation of the fascia propria recti along this posterolateral line of pelvic attachment and the opening up of the spaces with exposure of the lateral parametrial attachment of the rectum and vagina to the pelvic wall is a part of the *proposed operation of wide local excision of the rectum, uterus, and part of the vagina,* which is shown in this particular illustration in order *to compare it with* the method of enucleating the bowel in *close local excision of the rectum alone.* In the latter operation, the severance of the lateral sacral attachment *l' m'*, including the fibrous cord *m'*, and of a portion only, $m^1q$, of the line of attachment along the upper border of the lesser sacrosciatic ligament, *is all of the detachment of the posterolateral fascial connections of the fascia propria recti at the pelvic wall that should be done.* By this amount of fascial detachment the sacrosciatic space above the lateral parametrial attachment of the rectum and vagina to the pelvic wall is opened up just the same in this operation as in that for wide excision (Fig. 10). The difference in the approaches through the fascia in the two methods is that in the operation for

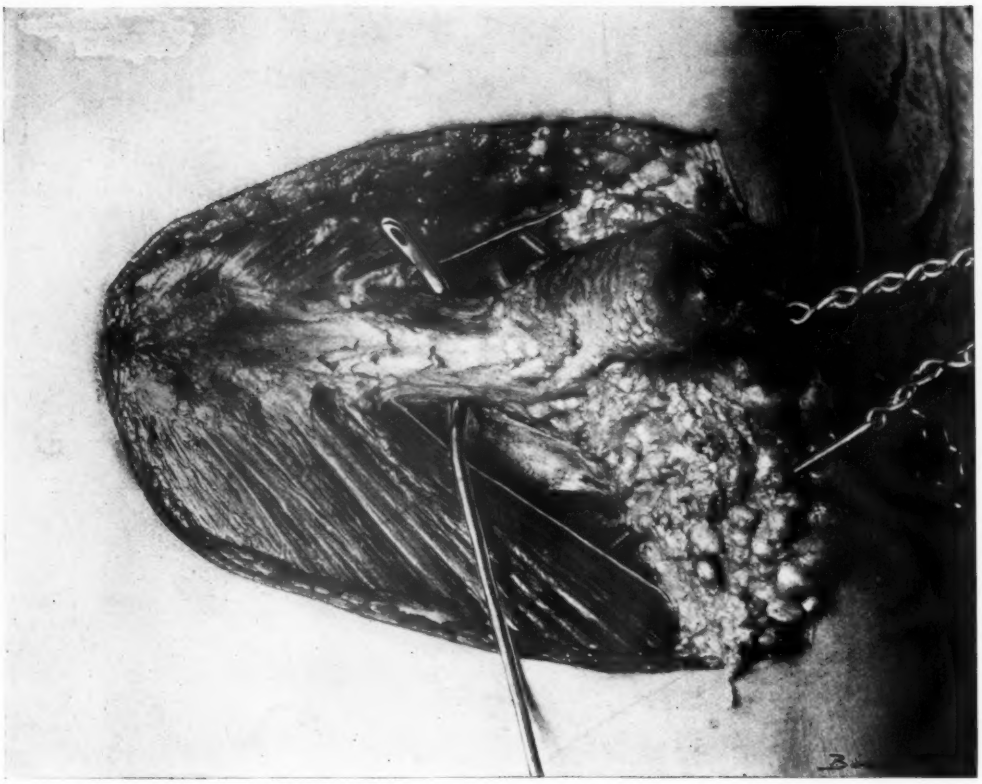
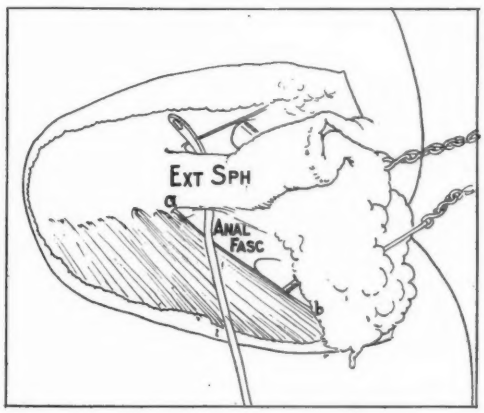
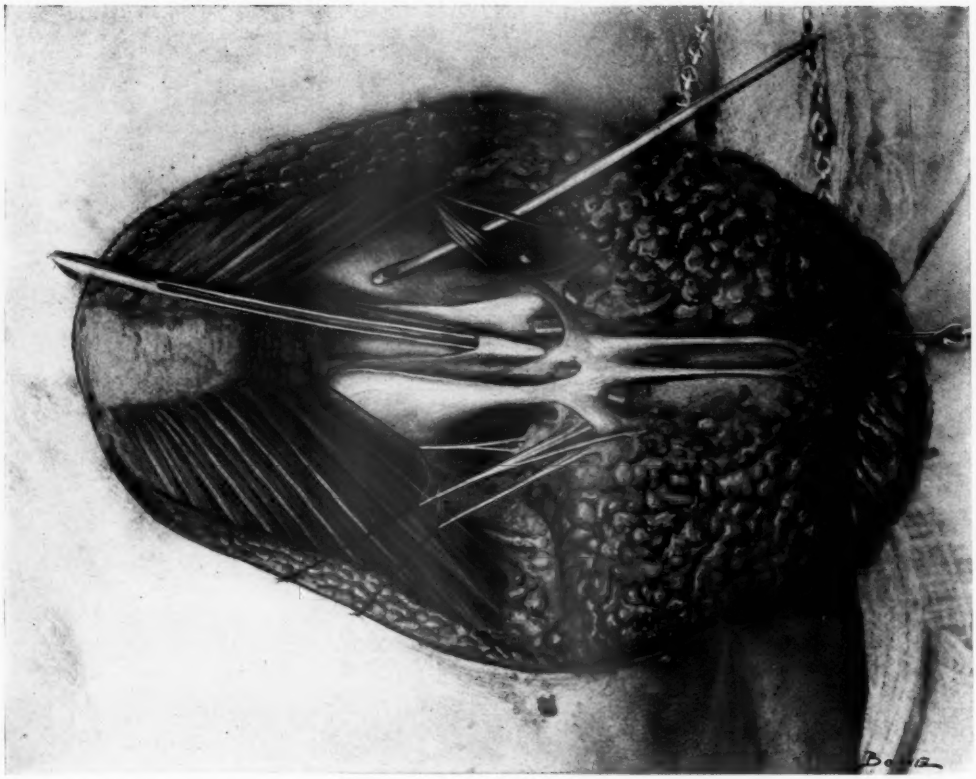


Fig. 1. Exposure of the posterior fibres of the external sphincter by the reflection of the horshoe skin flap. *a b*, fascia cut through at lower border of gluteus maximus to reach ischio-rectal fat. The hook passes between the posterior fibres of the external sphincter and the levatores ani, puncturing the reflection of the anal fascia one ither side.




wide local excision the vesicoparametriopelvic space is entered by separation of the visceral attachments along the line *x n*, while in simple enucleation of the bowel, the rectal sheath is opened directly into through the incision *q r* made a little posterior to *x n*.

Fig. 10. This illustration shows the fascial incisions *l m x n* and *l′m′ q r* outlined in Fig. 8, spread apart, and the underlying structures separated out, thus presenting comparatively these steps in the respective operations of proposed wide local excision of the rectum together with the uterus and part of the vagina (left side) and of close local excision of the rectum alone (right side). The differences of the two procedures here shown are described in the text under Fig. 9. Through the incision



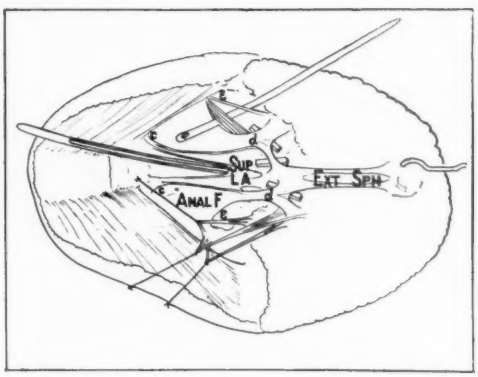
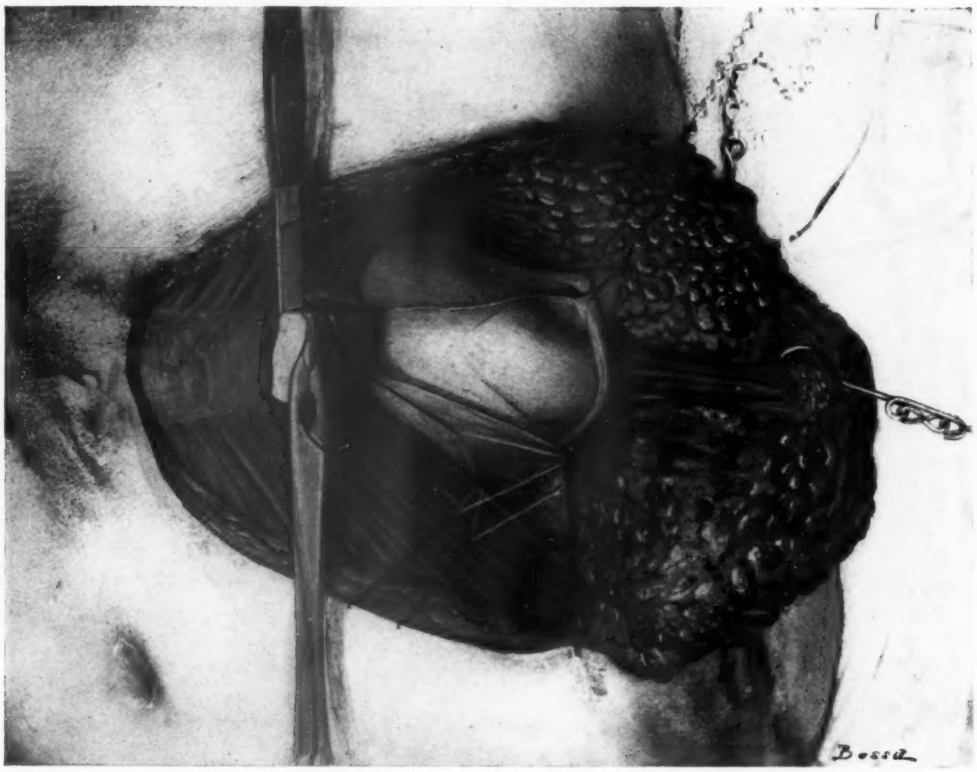



Fig. 2. Horseshoe flap with posterior fibres of external sphincter turned downward. *c d c d*, lines of cut anal fascia at the sites of its reflection onto the external sphincter on either side. The director passes beneath the superficial layer (here fascia, usually looped muscle fibres, *cf*, Fig. 14) of junction of the posterior fibres of the levatores ani (SUP L A). *e, e*, fascial archways of ischiorectal fossæ, where are found the inferior hæmorrhoidal vessels and nerves.

*q r* in the fascia propria recti shown in Figs. 8 and 9 (right side), cleavage between the longitudinal coat of the rectum and the sheath has been carried forward to behind the vagina. It can be seen in the illustration that the muscular fibers of the rectal wall have been followed for the entire separation and that the fascial compartment known as the prerectal space (Fig. 11 PR S and text) has not been entered, the plane of separation having continued behind this compartment. It is at this point that there would be liability of tearing a hole into the rectum, particularly if the walls of the latter have been made friable by disease. In enucleating the rectum through a lateral incision (*q r*) in its fascial covering, the writer has found that sometimes blunt dissection around the



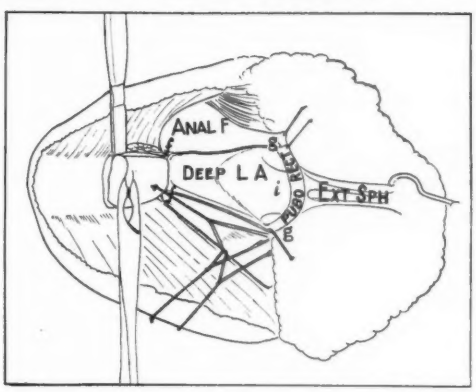



Fig. 3. The superficial layer of junction of the posterior fibres of the levatores ani (Fig. 2, SUP L A) has been cut, (*f g*, *f g*, retracted cut edges) exposing beneath the shiny median aponeurotic structure of the deeper layer (DEEP L A) of union of these muscles, and its aponeurotic termination (*i*) passing between the sphincters, from which the puborectalis muscle has been peeled back. Coccyx in course of excision.

bowel enters directly the prerectal space, and that again, as in the dissection here pictured, it does not. He is of the opinion that the difference in the results obtained can be explained by a variation in the textile strength of the fibrous sacs lining the prerectal spaces, in the former class of cases the sac being sufficiently thin to give way before the blunt force of the encircling finger against the posterior vaginal wall, and in the latter class of cases a firmness of structure of the sac resisting blunt opening of it. If the prerectal space be not opened up in cleaving the rectum from its surroundings by the encircling finger, entrance thereto can then be gained by making an incision (*s t*) directly down upon this fascial sac over the posterior aspect of the vagina, which is facilitated by first catching up the tissue to be cut with a

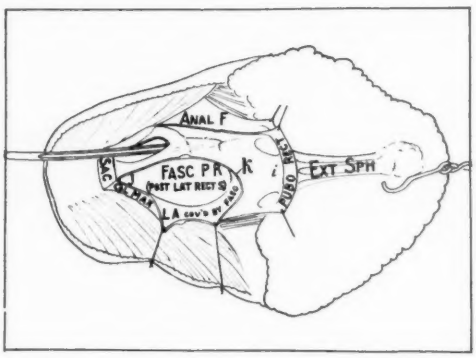
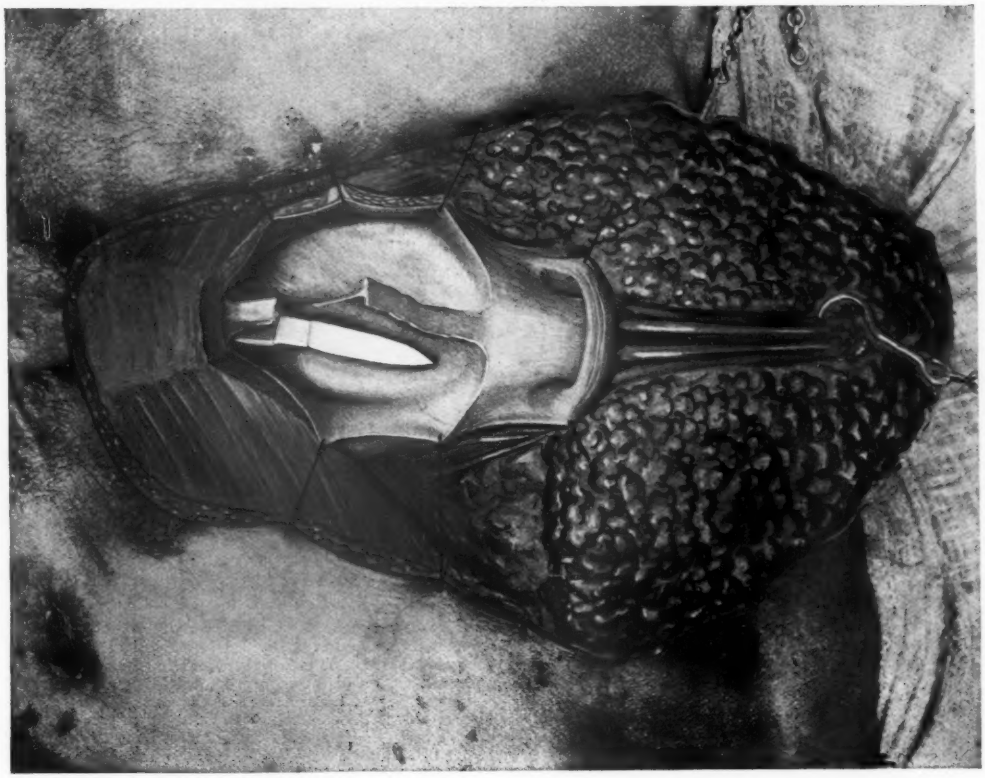



Fig. 4 shows the method of opening up the postero-lateral rectal spaces. P L R S, left postero-lateral rectal space opened up. Through the left opening (*j k*), the fascia propria recti (Waldeyer), (FASC P R) or rectal sheath is seen. A director has been passed into the right postero-lateral rectal space through an opening made a little to one side of the median line in the floor of the space from which the coccyx was removed, to indicate the method employed in the dissections of entering these compartments (for *operative method* of entering the second compartment, see text of this fig.). *i* aponeurotic insertion of levatores ani passing between the sphincters. L A, Levator Ani. SAC, tip of sacrum.

clamp, and making it taut. In this connection the technique of Kraske, who cuts the bowel across below before he divides its lateral and anterior connections, can be considered as an alternative which is easier of performance, and, when carefully done, probably not likely to invite more infection than would a technique in which division of the bowel is postponed until a final step. L R is the mass of tissue containing the lateral nervous and vascular structures going to the rectum (cf. Fig. 12 *hook* 1). Below it the bowel takes a lateral turn outward, thereby gaining an increase in caliber at this situation. All of the rectum below the level of L R is invested by a fascial sheath. Above L R this fascia covers only the



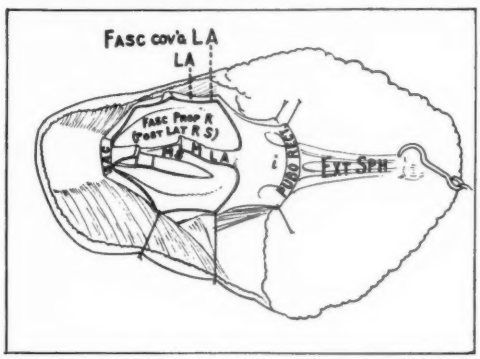
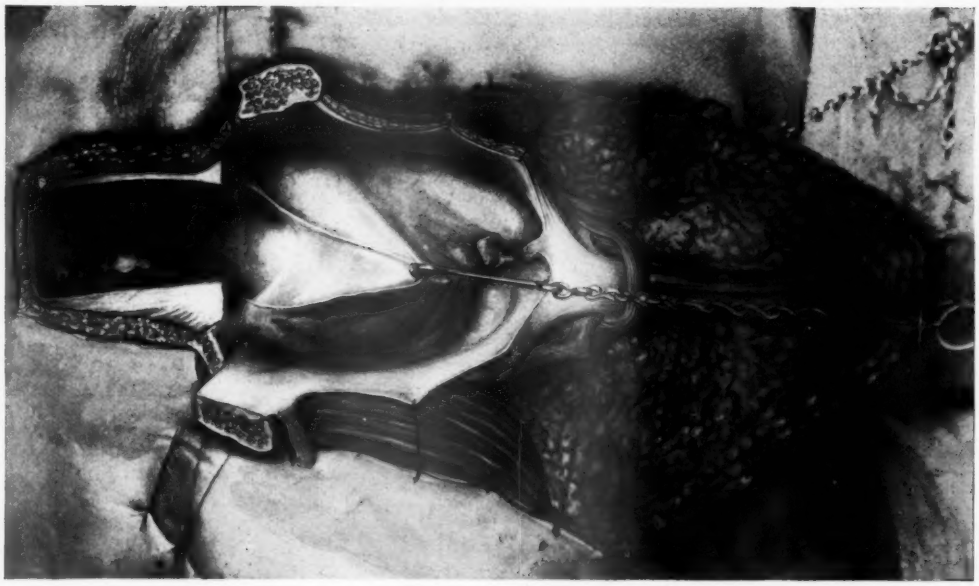



Fig. 5 shows method of entering retrorectal space in which the knife handle lies. The site of exit of the latter indicates the situation in the median line at the tip of the sacrum, where after entering the postero-lateral rectal spaces, pressure is made to readily strip the sheath of the rectum off from the bodies of the sacral vertebræ. M L A, median aponeurotic strip of the levatores ani, isolated by the parallel incisions of entrance into the postero-lateral compartments. In operating rather open into the second compartment by a transverse incision through the aponeurotic structure below the tip of the sacrum and then cutting the median septum (M S) (see text, fig. 4). FASC P R, fascia propria recti or rectal sheath. SAC, tip of sacrum. L A, Levator Ani.

posterior surface of the bowel and passes upward over the sacrum and laterally along the pelvic wall in close apposition with the peritoneum (see text Fig. 4, fascia propria recti).

Fig. 11. The *prerectal space* (PR S) has been entered through the incision *s t*. This space consists of a collapsed fibrous sac, in the female situated between the rectum and vagina, and extending above up to the cul-de-sac (C S). Normally, it is held collapsed by loose connective tissue between its surfaces, so that when entered, its walls can be easily stripped apart for its entire extent—a characteristic yielding of the tissues before the advancing finger being positive evidence of the space having been



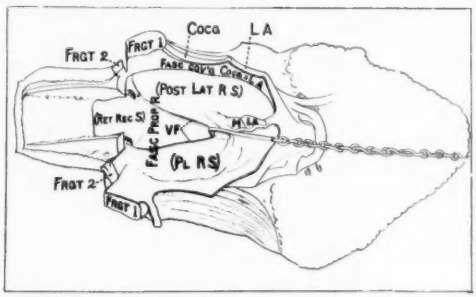



Fig. 6. Retrorectal space (RR S) exposed both by the resection just below the level of the lateral sacral angles, of the mesially divided lower end of the sacrum forming FRGT 1 on either side, and by the removal of a median section of the sacrum above this level. The line of transverse division of the sacrum liberating FRGT.1 on either side is the same as that of transverse sacral section in Fig. 38 (see Fig. 37 *h i*). FRGT. 2, FRGT 2, fragments split off opposite the fourth sacral foramina. V F V, shaped folds of delicate fascial attachment to front of sacrum between the fourth sacral foramina and the tip of the bone. *m m'*, fibrous cords of V-shaped folds, firmly attached to fascia propria recti. COCC, coccygeus muscle.

entered. The structures entering the rectum in the tissues (L R) around which the director has been passed consist of the middle hæmorrhoidal vessels, when present, and branches of the sympathetic nerves, as shown in illustrations 12 and 14. In order to encirle this tissue close to the rectum, an incision *u v* must first be made through the top of the fibrous sac forming the prerectal space, a little to one side of the median line, through which opening blunt separation of the tissues upward alongside of the cul-de-sac cleaves away the structures entering the rectum from those passing to the vagina. The reflection of the cul-de-sac comes into view as the rectum, stripped to the left, sags away. The sites of ligature of the structures close to the bowel (*hook* 1) in the operation for excision of the rectum alone, and of those at the pelvic wall (*hook* 2) in the operation of wide local excision of the rectum, uterus, and part of the vagina, are shown in comparison.

Fig. 12. The essential structures of the parametrium entering the rectum and vagina from the side wall of the pelvis are shown dissected out. These structures are the ones contained in the mass of tissue designated as L S in the illustrations, corresponding to the lower portion of the line of attachment of the parametrium (see p. 192) to the pelvic wall. They lie between two firm fascial folds reflected over them, one in front and the other behind extend-

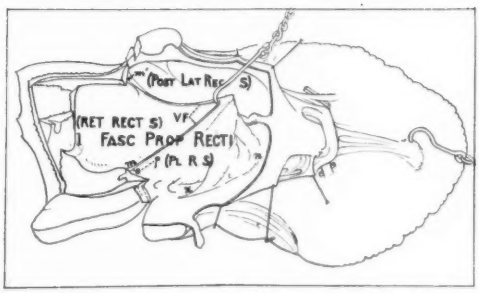



Fig. 7. Postero-lateral rectal (PL R S) and retro-rectal (RET RECT S) spaces on left side of the dissection widely opened up, showing the line *l m x n* of postero-lateral attachment of the fascia propria recti to the pelvic wall. *x* placed over spine of ischium. *m m'*, fibrous cords of V-shaped folds (V F). *l m*, lateral sacral attachment of fascia propria recti along inner margins of anterior sacral foramina. *m x*, attachment along upper margin of lesser sacrosciatic ligament. *x n*, attachment to the fascia covering levator ani, closely apposed to the upper portion of the attachment (Fig. 16 *w a*) of the posterior border of the parametrium to the white line. *o p*, incision to get beneath fascial attachments of the fascia propria recti preliminary to their division.

ing from the fascia of the side wall of the pelvis up to the sites of entrance of the structures into the rectum and the vagina. This fascial covering is entirely independent of the line of postero-lateral fascial attachment (*l m x n* Figs. 8 and 9) of the fascia propria recti to the pelvic wall. It affords a firm support to the rectum and vagina on either side, particularly at its lower extremity where it envelops the third and fourth sacral nerve branches to the sympathetic, at which situation it has a strong fascial connection along the third and fourth sacral foramina, which is distinctly noticeable for its toughness in operative work. The branches from the third and fourth sacral nerves are seen to unite with the inferior hypogastric or pelvic plexus (P P) of the sympathetic, from which branches are distributed upward along the rectum and downward along the vagina, while one branch goes to the bladder. These nerve attachments to the bowel likewise form a firm connection between the rectum and the pelvic wall, which have to be severed on the two sides in addition to the fibrous folds encompassing them, to permit drawing down of the bowel above this level. The next higher structure above these nerves is, when present, the middle hæmorrhoidal artery, which in this dissection was present, but in other dissections the writer has found this vessel very inconstant.

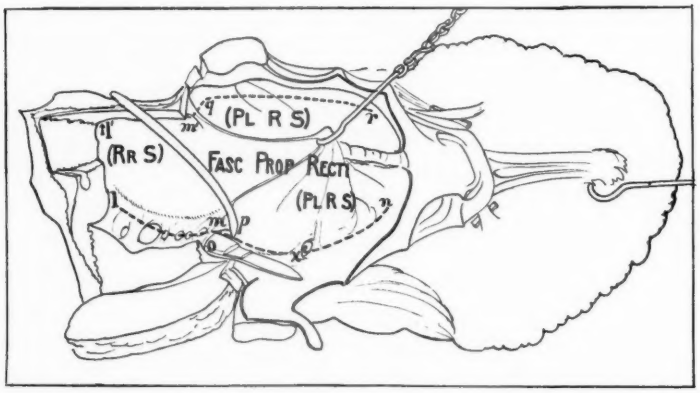



Fig. 8. The line *l m x n* of fascial separation of the fascia propria recti at the pelvic wall in the proposed operation of wide local excision of the rectum, uterus and part of the vagina, is shown in comparison with the line of fascial division *l' m' q r* in close local excision of the rectum alone (*cf.* Fig. 10). *l' m' q* on the right side is identical with the corresponding portion of the line *l m x* on the left. The main difference between the lines of fascial division is that at *x n* the rectal sheath is separated from the pelvic wall, while at *q r*, which is a little more posterior, the sheath is cut into. The scalpel handle introduced at *o p* enters the sacrosciatic space (Fig. 9 Ss S) and makes prominent the lateral sacral attachment (*l m*) of the rectal sheath. This attachment, between the cord *m* and the first sacral vertebra, is delicate and can be pressed through with the finger from within the retrorectal space, which technique affords the best method of access to the sacrosciatic space (*cf.* Fig. 33). The cord *m* must be cut. The hook introduced at *o p* and emerging at *x* raises the line of attachment of the fascia propria recti to the upper border of the lesser sacrosciatic ligament. *x* placed over spine of ischium at which point the finger pushed forward enters directly the vesicoparametrio-pelvic space (Fig. 9) and thence forced downward tears the attachments along the line *x n* from the pelvic wall.

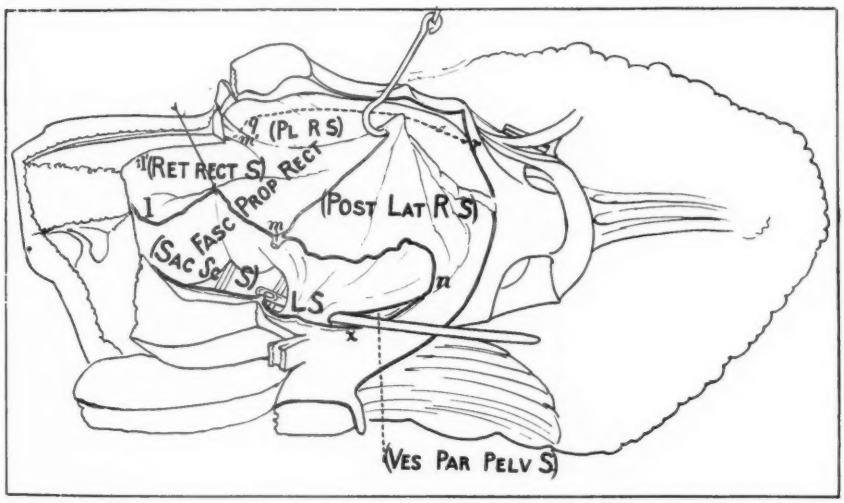



Fig. 9. On the left side of the dissection the detachment of the postero-lateral fascial connections (Fig. 8 *l m x n* and text) of the fascia propria recti to the pelvic wall is shown as performed in the proposed operation of wide local excision of the rectum, uterus and part of the vagina. The tissue (L S) consisting of the lower portion of the parametrial attachment (see p. 192) to the pelvic wall, and containing the arteries and nerves (Fig. 12) entering both rectum and vagina laterally, is thereby exposed at a situation where it can be tied close to the pelvic wall. Above it, is the sacrosciatic space (SAC SC) and below it the vesicoparametrio-pelvic space (VES PAR PELV S). *l' m' q r*, line of fascial division in simple enucleation of the rectum.

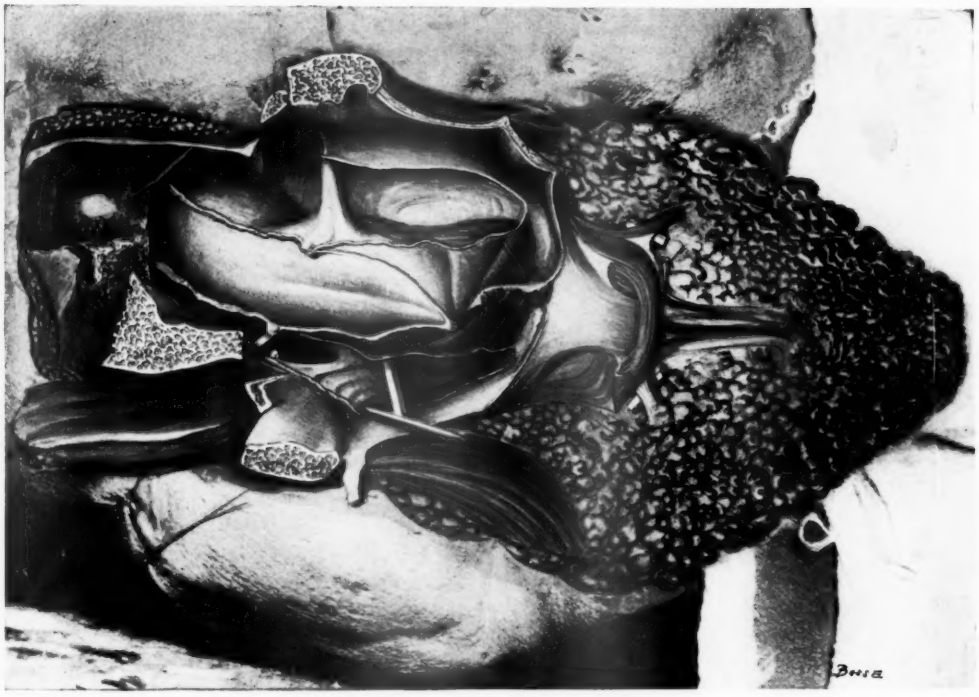


Fig. 10. See legend under key plate on opposite page.

Note that the site of meeting of the middle hæmorrhoidal artery with the rectum is lateral to the cul-de-sac which is the guide to finding the vessel close to the bowel. Next above the middle hæmorrhoidal artery is the vaginal artery, which was here a branch of the inferior vesical (Fig. 17). It usually comes from the the anterior branch of the internal iliac directly, or it may be an offshot of the middle hæmorrhoidal. In the dissection for Fig. 33, the writer found that an artery corresponding to the middle hæmorrhoidal and one going to the vagina both arose from the superior hæmorrhoidal distribution. The *hook* No. 1, passed alongside of the cul-de-sac and rectum through the top of the prerectal space, goes beneath the middle hæmorrhoidal artery and the sympathetic trunk to the rectum which together correspond to the tissue (L R) isolated close to the side of the rectum in Figure 11. The *hook* No. 2 is placed close to the pelvic wall beneath the structures at that situation, which enter both rectum and vagina laterally and would be tied off in the proposed operation for wide local excision of the rectum, uterus, and part of the vagina (see text Fig. 15). The vaginal artery here, arising as it does from the inferior vesical close to the bladder, would not be included in the ligature, as it would have been had its origin been sufficiently close to the pelvic wall. The ureter has been dissected out of its sheath and drawn inward and downward by a thread.

The remaining structures entering the parametrium along its line of attachment to the pelvic wall above the level seen in this dissection, are here added to complete the description of this fixed portion of the parametrium. They are, the inferior vesical vessels (Figs. 17 and 33) which pass forward just below the ureteral sheath, and the uterine artery which crosses above the same. With the exception of the

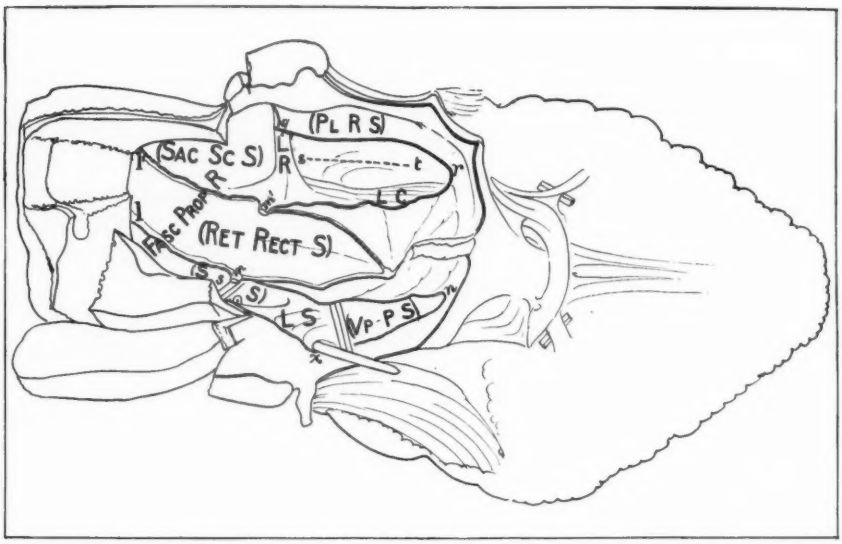



Fig. 10. This shows the fascial opening *l m x n* and the structures separated through it in wide local excision of the rectum, uterus, and part of the vagina (left side) compared with the fascial opening *l' m' q r* and the structures separated through it in close excision of the rectum alone (right side). L C, longitudinal coat of rectum which has been separated out of the rectal sheath to well behind the vagina. *s t*, line of incision to enter prerectal space. Ss S, sacrosciatic space. Vp-P S, vesicoparametrio-pelvic space. L R, tissue containing lateral vascular and nervous structures going to rectum alone (see Fig. 12) below the level of which the fascia propria recti (Fasc P R, see text, Fig. 4) covers the rectum posteriorly and laterally around to the side walls of the vagina, with which latter it is connected, thus forming here a true rectal sheath. Above L R the fascia propria recti extends from behind the bowel laterally in close apposition with the peritoneum along the pelvic wall. *x*, over spine of ischium. L S, tissue containing vascular and nervous laterally entering structures to both rectum and vagina.

vaginal veins, these upper structures have no distribution to the rectum or vagina. The relation of the fascia propria recti to the portion of the parametrium attached to the pelvic wall can also be noted in this connection. Fig. 33 shows that the whole hinder surface of this portion of the parametrium is overlaid by a reflection of the fascia propria recti (see text Fig. 4) which, around the site of entrance of the ureter into the parametrium, fuses with the latter to form what is here called the posterior fascial layer (Figs. 21 and 33 *g*) of the ureteral compartment of the parametrium.

Fig. 13. This shows the final steps of lateral detachment of the bowel. The isolated mass of tissue (L R Fig. 11) has been tied and severed, exposing fully to view beneath, the right lateral aspect of the cul-de-sac. Through an opening made in the cul-de-sac into the peritoneal cavity a director has been passed up alongside the bowel to indicate the line along which the lateral attachment of this portion of the bowel can be severed. In Fig. 25, there is shown the situation of this director within the peritoneal cavity. The lateral bowel attachments above the cul-de-sac consist of the apposed layers of peritoneum and fascia propria recti which, meeting a little to one side of the bowel (Fig. 29), pass outward on either side over the pelvic wall, forming the inner boundaries of the sacrosciatic spaces. By the division of these lateral attachments additional descent of the bowel, particularly its front portion, can sometimes be gained, but sometimes it cannot, when the failure to effect the descent is then due to the restraint exercised by a shortness of the fascia propria recti. When the latter condition is met, an additional descent of about two inches of the bowel can be gained by dividing the fascia propria recti transversely across over the back of the bowel and then stripping upward just in front of this layer,

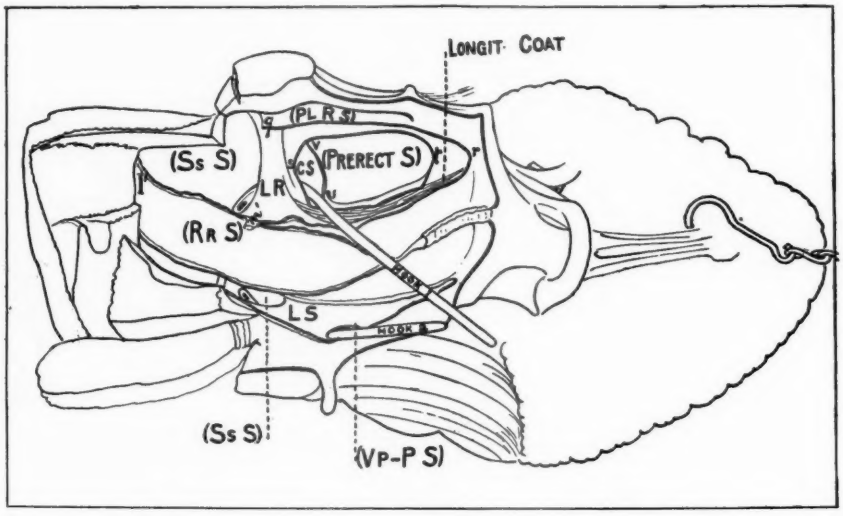



Fig. 11. The prerectal space (PRERECT S) has been entered through the incision *s t*, and through a lateral incision (*u v*) in the fascia forming its top an upward blunt dissection alongside the cul-de-sac (C S) separates out the tissue (L R) containing the laterally entering vascular and nervous structures of the rectum, close to the bowel. The sites of ligature of the laterally entering structures to the rectum close to the bowel (*hook No. 1*) and of those (L S) to both rectum and vagina at the pelvic wall (*hook No. 2*), are shown in comparison.

which separates forward the bowel together with its accompanying vessels and lymphatics (V B L Fig. 33), thus opening from below the pelvic retrointestinal plane of cleavage (Fig. 33). Then any remaining lateral attachment of the bowel restraining its descent must also be divided. In opening up this plane of cleavage from below, a median attachment of the fascia propria recti to the rectum, found below the level of the third sacral vertebra, must be severed.

Fig. 14 shows the dissected anatomy of the operative step in Figure 13. The middle hæmorrhoidal artery and the sympathetic cord to the bowel have been severed close to the rectum. The grooved director indicates the line along which the lateral combined peritoneal and fascial attachment of the bowel can be severed. A large vein lies just beneath the ureter, deriving branches from the bladder and vagina (cf. Fig. 17), and can be termed the *vesicovaginal vein* (VES VAG VE).

Fig. 25 in relation to the combined operation for close local excision of high-seated cancer shows the approach from above through the pelvic retrointestinal plane of cleavage, which exposes the superior hæmorrhoidal vessels for their ligature, the ureters at the brim for their avoidance, and the lateral peritoneal attachments of the bowel for their severance, and affords a route of access to the retrorectal space. (See text Fig. 25 seq.).

II. *Wide local excision of the rectum, uterus, and part of the vagina, en masse,* above the pelvic floor by the *combined* posterior and abdominal *routes.* (Figs. 1 to 9, 12, and 15 to 27).

The figures of this operative procedure show removal by cutting through the parametrium internal to the ureters, with the operation begun from below and finished above, which corresponds to the order in which the dissections were made, and therefore this same order is followed in describing the illustrations. However, as a matter of operative technique in the combined operation, for the sake of making an early determination of the extent of the disease and of the particular anatomy of the sigmoid flexure, as well as for the sake of more perfect asepsis and the elimination of one change in the posture of the patient, it would always be advisable, as Kraske recommends, to commence from above through a median abdominal incision and then complete the operation through the lower wound. Indeed, the later studies showed that the whole enucleation down to the seat of junction of the levator ani with the anus could be done quite effectually through the abdominal incision, so that with the anus left in situ, and the opportunity afforded of clamping the bowel off through the vaginal opening, a posterior approach would then be needed only in case a circular suture of the bowel ends were required to be done above the anus.

Figs. 1 to 9 show the posterior approach to the rectum through the horseshoe incision, and the detachment of the posterolateral fascial connections (*l m x n* Figs. 8 and 9) of the rectal sheath to the pelvic wall and floor, with the opening up of the sacrosciatic (see text Fig. 8) and vesicoparametrio-pelvic (see text Fig. 34) spaces and the display of the parametrial tissue (L S Fig. 9) containing the arteries and nerves entering the rectum and vagina laterally from the pelvic wall.

Fig. 12 shows the dissected anatomy of the portion of the parametrium (see p. 192), containing the laterally entering vascular and nervous structures going to the rectum and vagina.

Fig. 15 shows the isolation of the lower extremity (L S raised on *hook*, with which *cf* L S Fig. 9) of the parametrial attachment to the pelvic wall containing the laterally entering arteries and nerves going to the rectum and vagina. This dissection was made on the same side as that on which the steps of close local excision of the rectum alone were shown, so that the amounts of tissue removed in the two procedures could be compared. This comparison would seem to demonstrate practically the possibility of wide severance of the lateral lymphatics of the rectum in malignant disease, in the face of which it would seem that the proposition to divide them close to the bowel must soon be relegated to the past. *The amount of the lower extremity* (L S) *of the parametrial attachment to the pelvic wall to split off for ligature* should be sufficient to include the middle hæmorrhoidal and vaginal arteries, and leave untouched above the vessels to the bladder (Fig. 17). The interval between

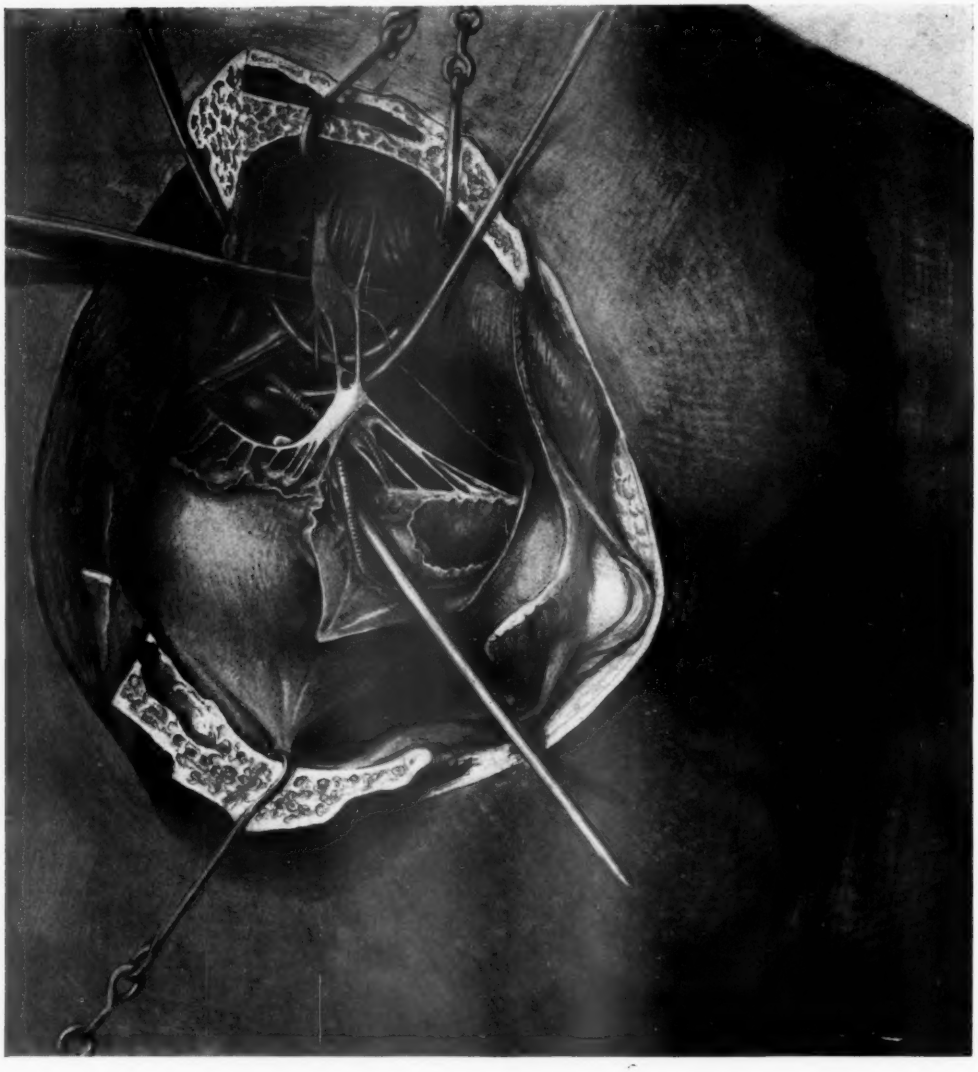


Fig. 12. Dissection of the lower portion of the parametrial attachment to the pelvic wall, showing the contained vascular and nervous structures which enter the rectum and vagina laterally. The ureter (UR) dissected out of its sheath, is drawn downward and inward by a thread. Hook 1 lies in the line of cleavage between the structures going to the rectum (Fig. 11 L R) and those going to the vagina, showing how the former can be isolated and tied close to the bowel. Hook 2 passes around the laterally entering middle hæmorrhoidal artery and the nerves to both rectum and vagina (Fig. 11 L. S), which are isolated and tied out at the pelvic wall in the proposed operation for wide local excision of the rectum, uterus and part of the vagina. The vaginal artery (VAG A) owing to its origin here from the vescial, is not included in the structures under the Hook 2 as it would have been if normally situated. PP, pelvic or inferior hypogastric plexus of sympathetic sending branches chiefly to the rectum and vagina. M HEM A, middle hæmorrhoidal artery (very inconstant). N BL, nerve to bladder. FASC P R, fascia propria recti. VAG, vagina. C S, cul-de-sac. PR S, prerectal space. Spine of ischium a little deeper than *x*. II S, second sacral nerve root. III S, third sacral nerve root. IV S, fourth sarcal nerve root. SUP and DEEP L A, superficial and deep layers of the posterior fibres of the right levator ani.

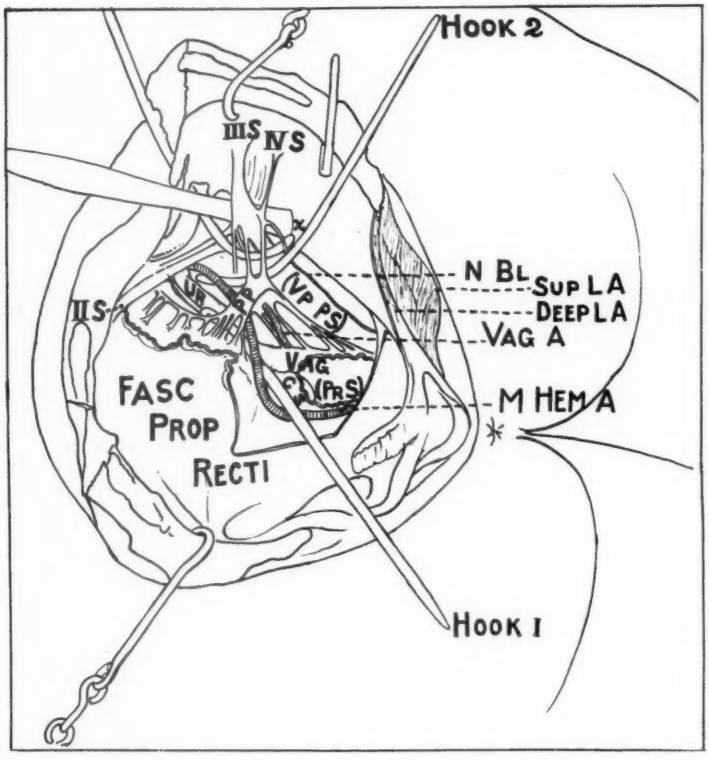



Fig. 12. Key plate.

these sets of structures can be located by palpation along the upper and lower surfaces of the attachment to the pelvic wall, through the sacrosciatic and vesicoparametriopelvic spaces respectively. Through the former space the guide to this interval is the deepest point the finger can touch, which is just below the ureteral compartment of the parametrium (see text Fig. 19). Through the vesicoparametriopelvic space the guide is the spine of the ischium, about half an inch deeper than which can be located an inferior point situated opposite the upper one. Between these two points the structure of the parametrial attachment to the pelvic wall is generally thinned. The tissues thus marked off are the proper amount to isolate and tie. A too deep grasp might possibly include the ureter, rather than take any chance of doing which it would be better to leave any doubtful tissue to tie off at a later step in the operation. When the attempt is now made to pass a ligature carrier through the tissues at the selected point, considerable resistance will be met from the two fascial layers sheathing, one above and one below, the laterally entering structures. Therefore, to facilitate separation of the tissues at the site indicated, the lower fascial layer can be scratched through with the point of a scalpel and then through the opening thus made the upper layer is easily penetrated by the instrument. From this point of puncture the tissues are split inward with blunt force. Here the direction of the structures gives some guidance, that of those entering the rectum and vagina being from without inward, while the ureter and its accompanying vessels to the bladder pass from above downward. The nervous and

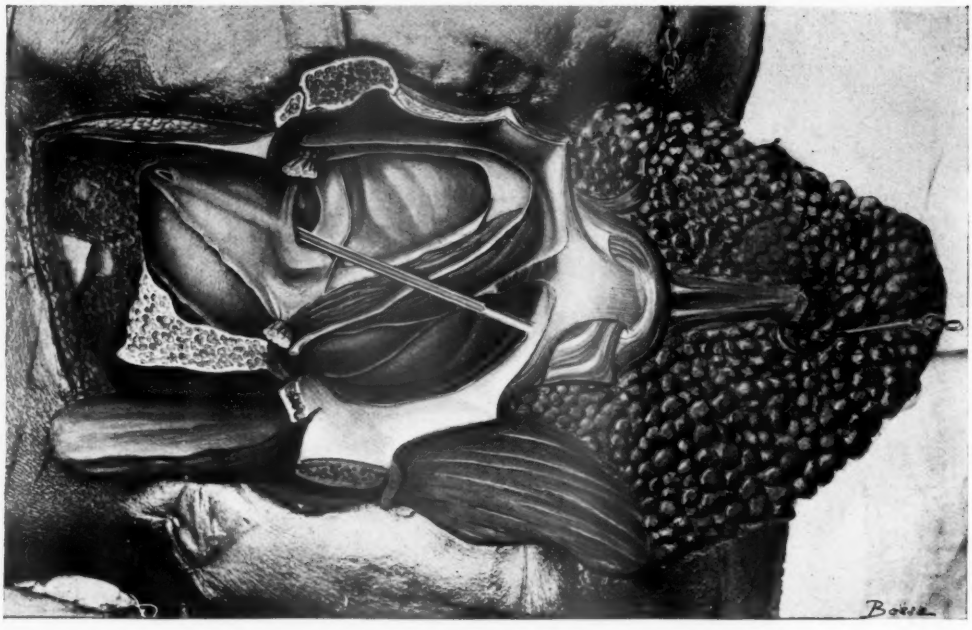


Fig. 13. See legend under key plate on opposite page.

vascular structures which may be included in the isolated tissue are illustrated in figures 12 and 17. They are, branches from the third and fourth sacral nerves to the sympathetic plexus, the middle hæmorrhoidal vessels, when present, and the artery to the vagina, unless this vessel arises too centrally, as in this dissection where it arose from the artery to the bladder, and was therefore situated too deeply to be isolated at the pelvic wall. The writer has found from a number of dissections that the middle hæmorrhoidal vessels are very inconstant. Thus, as one isolates this lateral attachment of the rectum and vagina for ligature, he may feel two vessels pulsating in the mass, but there may be only one, either from the absence of the middle hæmorrhoidal artery or a too central origin of the vaginal. Or there may be no vessel felt at all because of the simultaneous existence of the two latter conditions, or because of an anomalous origin of these two vessels from the superior hæmorrhoidal artery as was found in the dissection for Fig. 33.

Fig. 16. The right isolated mass of tissue L S has been tied as close as possible to the pelvic wall and severed, whereby the sacrosciatic and vesicoparametriopelvic spaces are thrown into one. The ligaturing of this mass after its isolation, can be done by first catching it close to its visceral attachment with a clamp which serves as a holder, and then transfixing it as closely as possible to the pelvic wall with a ligature which first ties one side of the transfixed tissues and then, being made to encircle the whole mass, ties it all together. A better way would probably be to first trim away the lower portion of the parametrial attachment to the pelvic wall, consisting of the firm fascial attachments around the third and fourth sacral foramina and their contained nerve branches, after which the more deeply situated vessels could be tied in less tissue. In most cases on the female cadaver these laterally entering structures could be tied, though a little awkwardly, through the approach by the horseshoe flap without resecting the lower extremity of the sacrum below the fourth sacral foramina.

Fig. 17. The dissected structures connecting

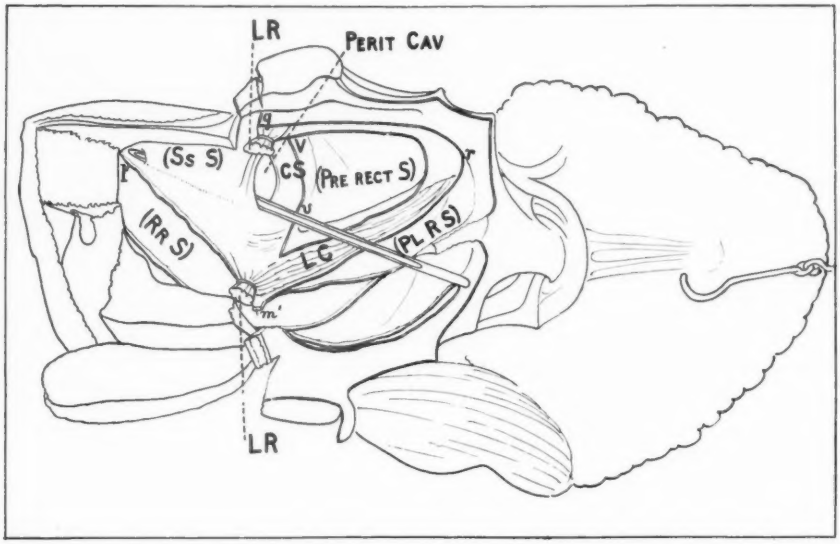



Fig. 13 shows the final steps of lateral detachment of the bowel. (cf. Fig. 14.) The isolated tissue containing the laterally entering vascular and nervous structures to the rectum (L R) has been tied and severed, thereby freeing the rectum from this site of fixation. The director introduced through an opening in the cul-de-sac (C S) into the peritoneal cavity, indicates the line along which the lateral fibro-peritoneal attachment of the bowel can be severed. In Fig. 25 the same director is shown from within the peritoneal cavity. PR S, prerectal space, at the top of which the site of the incision *u v* (Fig. 11) is seen, through which isolation of the laterally entering structures of the rectum was attained. Ss S, sacrosciatic space. L C, longitudinal coat of bowel.

the rectum and vagina to the side wall of the pelvis (Fig. 12 *hook* No. 2) have been severed (cf. Fig. 30 *hook* No. 2). They are here, more superficially the nerves from the third and fourth sacral roots to the sympathetic plexus, and deeper the middle hæmorrhoidal artery. The vaginal artery which lies deeper than the middle hæmorrhoidal vessels would also have been included in the isolated tissue, if its origin had been sufficiently lateral, but here arising from the artery to the base of the bladder, it was too centrally located to be grasped by the ligature at the pelvic wall. After these severed structures have been turned to either side, the deeper dissection presents the relations of the ureter which has here been replaced from the position, into which it was drawn by the thread in Figs. 12 and 14, into its normal situation. Lying internally to the ureter are seen from this aspect the vascular structures which are severed through the abdominal incision in the outward separation of this urinary conduit. These are, below the ureter, the vaginal branches (VAG. VE. cf. RT. VAG. VE. Figs. 22 and 23) of the vesicovaginal vein, and above the ureter, here seen lying in the shadow, the stumps of the uterine artery which was tied and severed through the abdominal incision.

*A method of exposure of the parametrial portion of the ureter in its sheath* is shown in Figs. 18 to 21.

Fig. 18. The bladder is raised from the front of the vagina, showing a fascia-lined compartment opened up, which is termed the prevaginal space (Pv S). This space is entered first by incising the peritoneum transversely, a little behind the base of the bladder and then cutting carefully through a little loose connective tissue beneath, in front of the cervix, until the hard uterine tissue is reached, after which blunt stripping downward with the scalpel handle will complete the entrance. *y z* is the line of vertical incision at the side of the vesicovaginal space below the uterine artery, made directly down upon the vaginal wall and going through the fascial lining only, through which

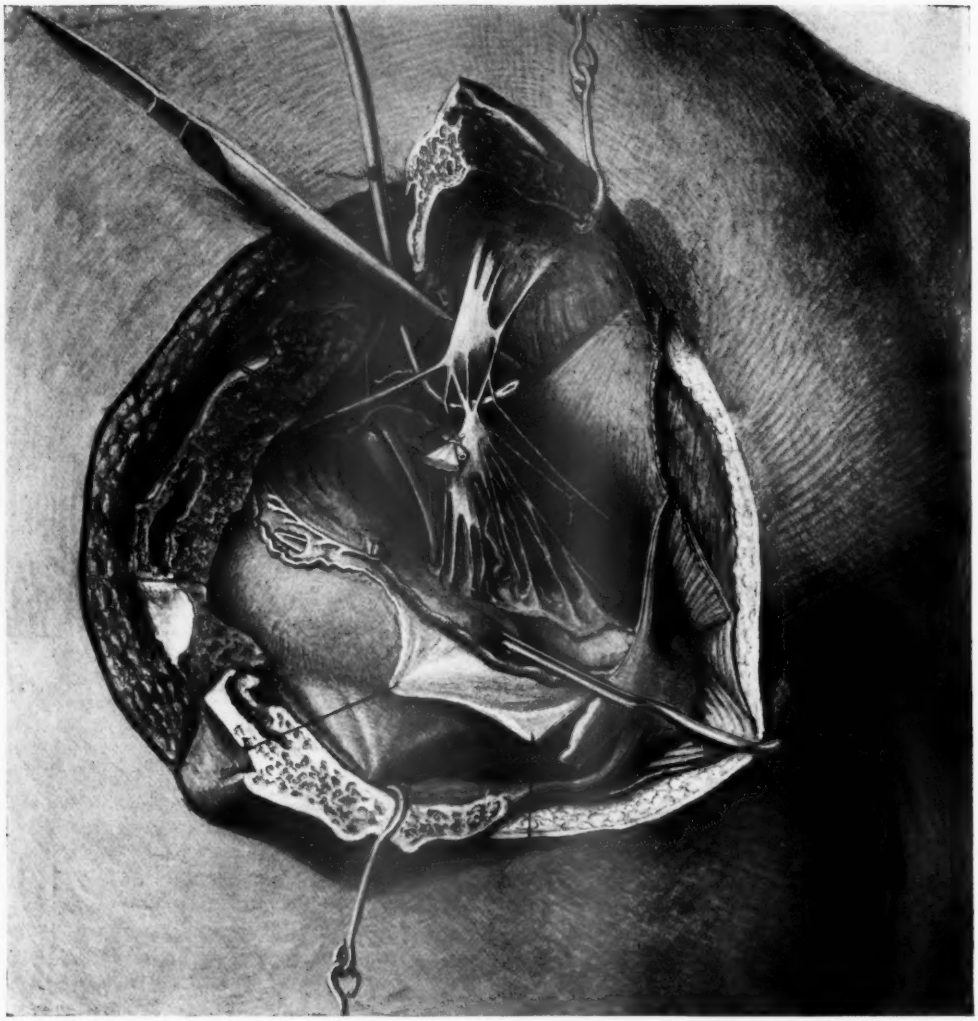


Fig. 14. See legend under key plate on opposite page.

blunt separation in a direction outward and a little backward opens up another fascia-lined compartment (cf. Fig. 33 Uv S) about an inch and a half in depth between the lateral vaginal wall and the vesical extremity of the ureter. This compartment can be termed the *uretero-vaginal space*. The direction of the plane of separation is indicated by the inclination of the stick *c* in Fig. 19. To open this fascial compartment successfully without disturbing the ureter, the incision *y z* should be made onto the vaginal wall and the scalpel handle or blunt scissors should be made to hug the lateral vaginal wall and raise forward from it the overlying tissues containing the ureter. If *y z* is cut a little external to the vaginal wall, the separating

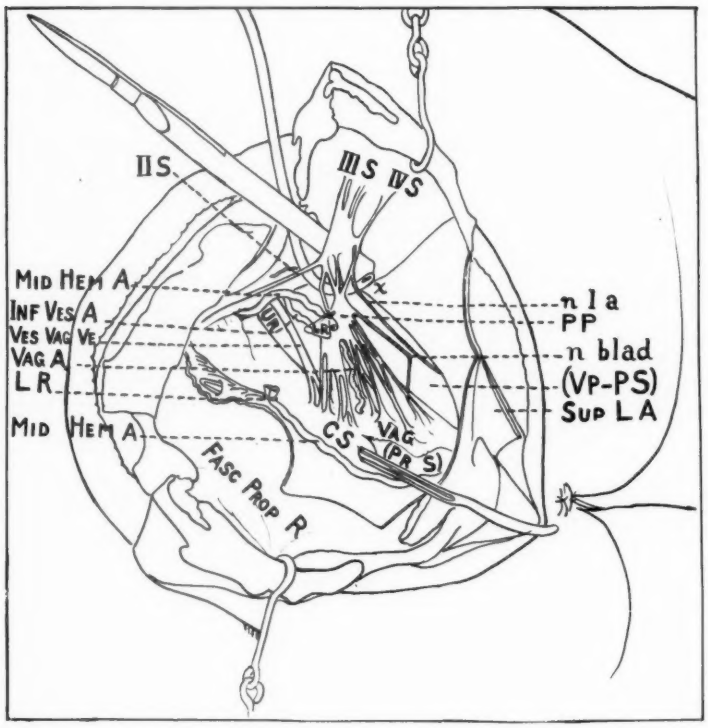



Fig. 14 shows the dissected anatomy of the operative step in Fig. 13. L R, L R, stumps of severed vascular and nervous sructures (middle hæmorrhoidal artery — very inconstant — and sympathetic nerves) entering the rectum laterally. Spine of ischium a little deeper than *x*. VAG, vagina (lateral margin). PR S, prerectal space. C S, cul-de-sac. II S, III S, and IV S, second, third, and fourth sacral nerve trunks. P P, pelvic plexus of sympathetic. *n l a*, nerve to levator ani. *n blad*, nerve to bladder. MID HEM A, middle hæmorrhoidal artery. INF VES A, inferior vesical artery. VAG A, vaginal artery. VES VAG VE, vesico vaginal vein. SUP L A, superficial layer of junction of the posterior fibres of the levatores ani, here formed of muscular loops (cf. Fig. 2). UR, ureter drawn downward and inward into view.

instrument will then pass in front of the ureter and separate the tissues external to it. This technique is most easily accomplished, if a central point of the anterior vaginal wall be pulled upward and forward by a clamp, which makes the lateral vaginal wall and its attached tissues taut to direct the separating instrument. The scissors is perhaps the best agent to employ for effecting the separation, since by opening the blades at a deep point of cleavage and then withdrawing the instrument, the stretching thus effected causes an always wider opening up of the compartment. Mackenrodt (137) calls attention to the fact that, if the bladder is pushed from its attachments downward and laterally to the outer side of the anterior vaginal wall, the ureters appear, but his technique is a description of the use of blunt force, and not a method of dissection. *a b* is the line of transverse incision above the uterine artery going through the structure of the broad ligament down to the peritoneum forming the posterior fold of the broad ligament. Through this incision the peritoneum can be stripped backward from the parametrium lying in front of it, in doing which the stripping should be carried from alongside the uterus and vagina outward so that the ureter in its surrounding tissue is pushed into the outer wall of the space. Here again, if care be not taken to keep internal to

Fig. 15. See legend under key plate on opposite page.

the ureter, the separating instrument may pass above it and strip the tissues from its outer side. The opening here effected can be called the *retroparametrial opening*.

Fig. 19. The ureterovaginal space (Uv S) and retroparametrial opening (Rp O) entered by the incisions *y z* and *a b* Fig. 18, below and above the uterine artery respectively, are opened up, whereby the adjacent portions of the ureter which lie external to the fascial wall of each pocket, are separated outward, and the included portion of the parametrium is isolated in front and behind. The isolation of this portion of the parametrium affords a favorable approach for the ligature, internal to the ureter, of the uterine artery which lies in a fascial plane on the crest of the parametric tissue, as well as for the ligature of the vaginal veins which lie below the level of the ureter. The fascia covering the uterine artery has been incised and reflected to expose the vessel. In the ureterovaginal space the ureter, picked up in the fascia lining the space, is held by a pin so as to show in relief, thus demonstrating its location external to a fascial layer which would be a protective influence in cleaving this plane of separation. Within the retroparametrial opening a slit in its outer wall discloses the situation of the ureter likewise lying external to a fascial partition (fascia propria recti Fig. 33). Within this opening the incision *d e* is made in the fascial upper covering (*g*) of the parametrium a little behind the uterine artery, for the purpose of entering a triangular plane of cleavage just beneath the fascia supporting this vessel, which when opened up discloses at its outer border the ureter lying in its sheath (Fig. 21). This plane of cleavage is denominated in this work the *ureteral compartment of the parametrium* (Figs. 21 and 33 Ur C). The fascia (*g*) covering it in above and posteriorly, through which the incision *d e* is made, is part of the lateral reflection (Fig. 33 *g*) of the fascia propria recti which at this level fuses with the parametrial tissues.

Fig. 20. Through the incision *d e* Fig. 19, the plane of cleavage (ureteral compartment of the parametrium) beneath the fascia on which

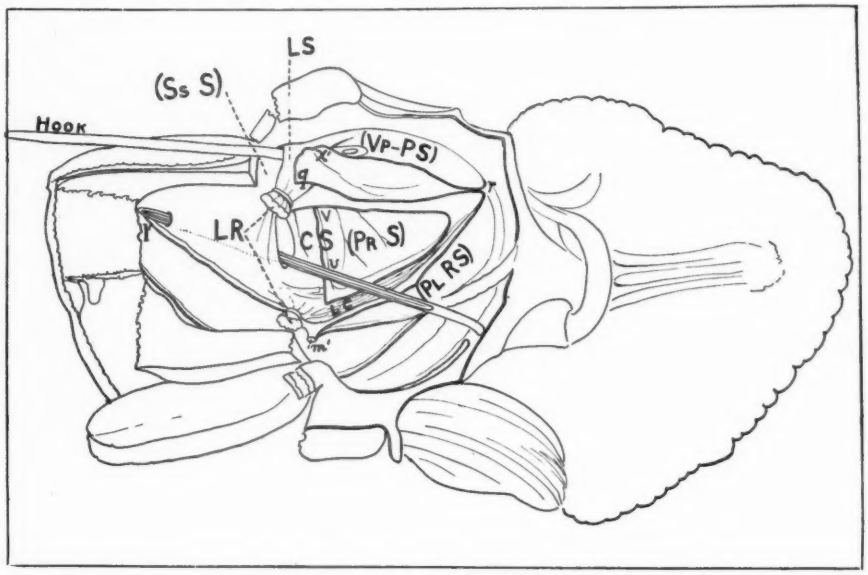



Fig. 15 shows on the right side the site of tying, out at the pelvic wall, the parametrial tissue (L S, raised on hook) containing the laterally entering arteries and nerves (see Fig. 17) going to both rectum and vagina, in proposed wide excision of the rectum, uterus, and part of the vagina, in comparison with the site of dividing the tissue (L R, L R) containing the lateral vascular and nervous structures going only to the rectum, in excision of the rectum alone (cf. Fig. 13) *x' r* edge of fascial attachment of the rectal sheath to the fascia covering the levator ani, which in conjunction with the attachment (see Fig. 16, *w a*) of the posterior border of the parametrium to the white line, lying adjacent, has been freed in the operation of proposed wide excision of the rectum, uterus, and part of the vagina (for method of freeing see text of Fig. 8). thereby opening into the vesicoparametrio-pelvic space (Vp-P S) beyond, compared with the line of incision *q r* into the rectal sheath for shelling out the bowel in close local excision of the rectum alone.

the uterine artery lies is opened up, and a hook inserted by this route catches up the artery in its surrounding tissues. Care should be taken in opening up this plane of cleavage to work the looser tissues outward with the scalpel handle away from the firmer inner wall of the space, thus pushing the ureter outward. Again here, if these directions be not followed, the cleavage may be carried across the ureter in the course of the uterine artery, to its outer side.

Fig. 21. The uterine artery together with its fascial surroundings has been divided between two ligatures in the line of the hook Fig. 20, and the stumps drawn apart, disclosing beneath the triangular area (ureteral compartment of the parametrium, Ur C), at the outer side of which the ureter lying in its sheath is seen, coursing from above obliquely downward and inward. If the external stump of the severed uterine artery be followed outward, it is found to cross above the ureter at the posterior angle of this triangular area, at which situation the artery is a guide to the ureter. The artery may be of use in locating the ureter in fat people where a thick coating of fat may obscure its identity or in cases where the ureter may have inadvertently become stripped inward instead of outward. The uterine artery gives off its branches to the ureter a little external to its site of crossing the latter, they running in the membrana ureterica (Fig. 34 M U). Notice that within the ureteral compartment of the parametrium the ureter in its sheath comes plainly into view, while in the ureterovaginal space and the retroparametrial opening this structure, lying external to deep fascial coverings is not normally seen. Downward separation from within the ureteral compartment along the ureteral sheath raises the tissue *f* and pushes through into the ureterovaginal space, opening

Fig. 16. See legend under key plate on opposite page.

a channel of separation in which the short stick is laid.

Fig. 22 shows the ureteral compartments (UR C cf. Fig. 33) of the parametria on the two sides opened up. The dissection on the left side is similar to that shown in Fig. 21 on the right, without the ureter having been dissected out in the retroparametrial opening or drawn into relief in the ureterovaginal space. A vaginal vein (LT VAG VE) is here seen. On the right side, the bridge of tissue (*f*) under which the stick was passed in the preceding illustration, has been cut across, and the cut ends of tissue (*f f*) reflected, exposing the underlying portion of the ureter to view. A hook raises the tissue RT VAG VE containing the vaginal veins which pass outward beneath the ureter to empty into the vesicovaginal vein (see Figs. 17 and 23 VAG VE), and includes the fascial floor on which they lie. The fascial floor supporting the vaginal veins is the lower portion of the layer *g* (Fig. 33) which joins below with the fascia forming the floor of the ureterovaginal space. In some instances, the vaginal veins can be raised off from their supporting fascial floor. The hook here has been pushed through the fascial lining of the ureterovaginal space out into the vesicoparametriopelvic space opened up by the dissection below (Fig. 23), and been made to re-enter the ureteral compartment of the parametrium through the fascial layer *g*. This encirclement therefore includes the base of the layer *g*. The tissue RT VAG VE is then tied and severed, thereby freeing the ureter from the side wall of the vagina, except for the rest of the fascia *g* which can now be cut, and also a lower attachment to the bladder (Fig. 31 *n*) below the ureterovaginal space.

Fig. 23. The instrument encircling the

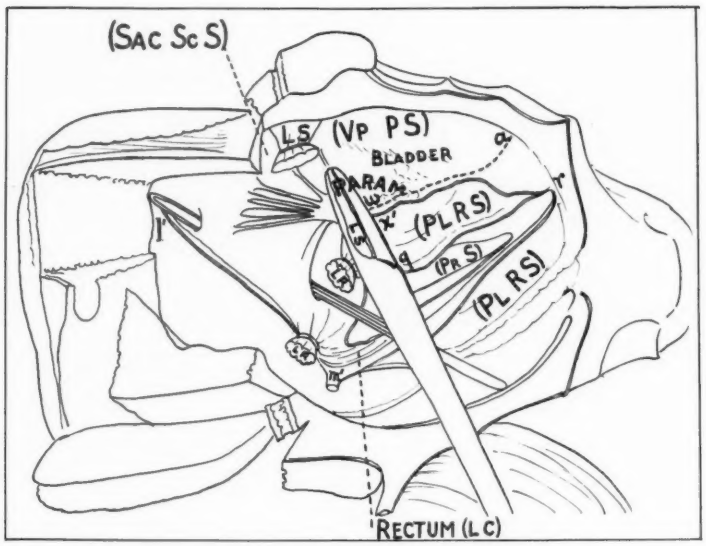



Fig. 16 shows the tissue L S (lower portion of the parametrial attachment to the pelvic wall), containing the late rally entering arteries and nerves to the rectum and vagina, tied and severed at the pelvic wall (see Fig. 23), whereby the sacrosciatic (Ss S) and vesicoparametrio-pelvic (Vp-P S) spaces are laid into one. *w a*, line drawn along situation of posterior border of parametrium, which has been split off from its attachment to the white line in conjunction with the attachment *x' r*. PARAM, parametrium. L C, longitudinal coat of rectum.

veins to the vagina and their underlying fascia in the preceding illustration, is seen through the lower wound, to have entered the vesicoparametrio-pelvic space, thus showing the situation of the line of severance of the vaginal veins from this aspect. The inferior vesical vessels are left with the ureter in the outer tissues.

Fig. 24. On the right side shows the tissue Rt Vag Ve Fig. 22, containing the vaginal veins and underlying fascia, tied and cut, thereby opening through into the dissected space beneath in which the stumps (L S) of the severed lateral, rectal and vaginal attachment to the pelvic wall come into view. On the left side the hook raises the tissue containing the vaginal veins (Lt Vag Ve) lying in the ureteral compartment (Ur C) of the parametrium.

Fig. 25 indicates an anatomical method of cleaving the rectum and adjoining portion of the sigmoid from their posterior attachments (see also Figs. 28, 29, 30, and 33, *pelvic retro-intestinal plane of cleavage*), and shows the arterial supply to the sigmoid. In this specimen, owing to the dissection below, the upward and forward traction on the uterus draws the bowel entirely away from the sacrum. The incision of approach to the selected plane of cleavage behind the bowel attached to the true pelvis, is indicated by the opening in the peritoneum *j k*, and is made in a line along the left side of the fifth lumbar vertebra and promontory corresponding to the situation of the terminal branches of the inferior mesenteric artery. The superior hæmorrhoidal artery is then located in the subserous tissue, and an opening is carefully (see relation of common iliac vein Fig. 26) teased at the right side of this vessel through the layer of fascia (V B L) on which the artery lies, to enter the plane of cleavage sought for, which is located between this more superficial layer of fascia and a deeper one beneath it covering the sacrum and adjoining pelvic wall. The former layer of fascia, through which the opening was made alongside the superior hæmorrhoidal, artery, contains considerable cellular tissue and extends over the back of the lower sigmoid and rectum as well as up-

Fig. 17. See legend under key plate on opposite page.

ward between the peritoneal leaves of the meso-sigmoid, supporting the blood-vessels of this locality to and from the bowel together with their associated lymphatic structures, and, from the function it serves, can be called the *vascular bowel layer* (V B L). The other deeper layer of fascia lying against the pelvic wall is the same as that designated as the *fascia propria recti* (see text Fig. 4) in the illustrations of the posterior dissections (cf. Figs. 4 to 10 Fasc P R). The space opened up between these two layers, which it is proposed should be entered at the beginning of every operation contemplating the removal of the rectum by the abdominal route, can be designated as the *pelvic retrointestinal plane of cleavage* (see also

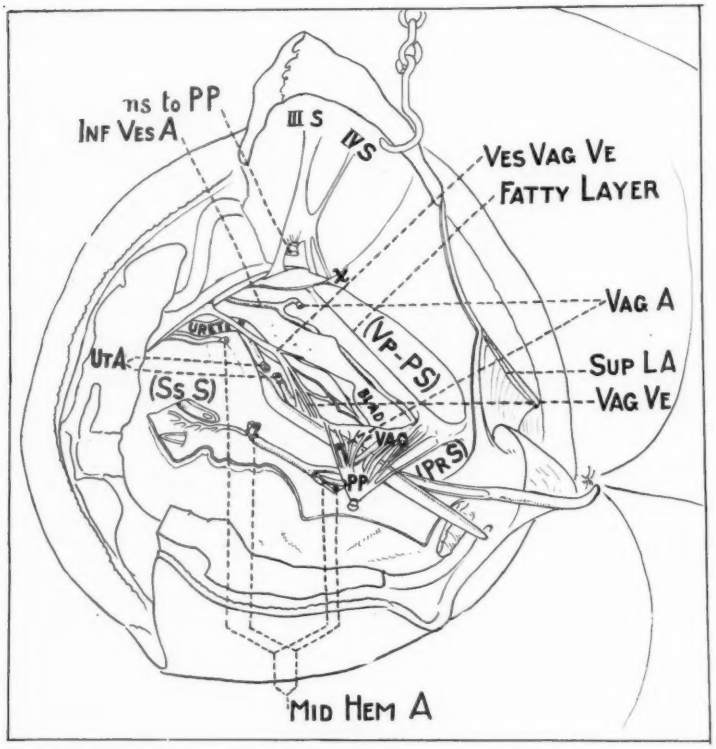



Fig. 17. The middle hemorrhoidal artery (M HEM A) and the branches from the third and fourth sacral nerve to the pelvic plexus (P P) here connecting the rectum and vagina to the side-wall of the pelvis (see Fig. 12, hook 2), as well as the vaginal artery here arising from the inferior vesical artery (INF VES A) have all been divided and turned aside to show the relations of the underlying portion of the ureter. These divided structures are the ones which when normally situated are contained in the tissue L S raised by the hook in Fig. 15. Ureter (a little dried) replaced in normal position. VES VAG VE, vesico vaginal vein lying immediately beneath ureter. VAG VE, vaginal veins, tied in operation 11, internal to ureter (Fig. 22). UT A, stumps of uterine artery tied and severed through median abdominal wound. The hook enters the peritoneal cavity and loops around a segment of the lateral fibro-peritoneal attachment of the bowel. F L, fatty layer padding the posterior portion of the vesicoparametrio-pelvic space, its outer and inner surfaces being here stripped free (cf. Fig. 34, U.) Spine of ischium a little deeper than *x*.

Figs. 28, 29, 30, and 33), as distinguishing it from the space opened up between the fascia propria recti and the bodies of the sacral vertebræ, which is the *retrorectal space* (Rr S, see text Fig. 5).

*Pelvic retrointestinal plane of cleavage.* An anatomical advantage of utilizing the pelvic retrointestinal plane of cleavage is, that in it separation of the tissues can be carried laterally out to the brim on either side to the situation where the ureter can be seen crossing the iliac vessels; while if the retrorectal space close to the sacrum be entered instead, at its upper portion the finger will then be prevented from lateral stripping by the firm lateral sacral attachments (Fig. 26 *l m'*) of the fascia propria recti to the front of the body of the first sacral vertebra, which overlie the iliac veins. Thus, by utilizing preferably this intermediate plane of separation of the structures, while the vessels and lymphatics in close relation with the bowel are separated forward, the former being exposed for ligature, at the same time the ureters in their sheaths are readily exposed at the brim for their avoidance in cutting the peritoneal flaps, and the internal iliac arteries

Fig. 18. See legend under key plate on opposite page.

covered only by the deep fascia, are brought into reach for their ligature if desired. The left ureter is more easily viewed at the brim after the superior hæmorrhoidal vessels have been severed. Another advantage of the approach through the pelvic retrointestinal plane of cleavage, is the ability to enter through it the superior (Fig. 28 Z), middle (Fig. 32 hook), and inferior (Fig. 33 to Pl R S) recesses, by doing which the pelvic wall attachments of the mass to be removed, are subdivided and isolated in a way to permit of their severance in a systematic manner. Also, this primary posterior dissection enables the centrally located organs to be raised higher in the pelvis, thereby elevating as well the peripheral attachments and so favoring accessibility to the field of operation. Likewise an idea of the extent of the local growth may be gained at the start by palpation along the recesses which can be entered through this plane of cleavage, in cases of uncertain operability.

*Surgical importance of the portion of the fascia propria recti reached through the abdominal route* (cf. text Fig. 4). The fascia propria recti sometimes unites in a transverse line with the vascular bowel layer at about the middle of the sacrum, which is the condition seen in this illustration, though usually the cleavage between the two layers extends down to the tip of the sacrum (Fig. 33). Here this fascia has been simply torn through at its lower limit into the retrorectal space (Rr S) already opened up by the partial enucleation of the bowel through

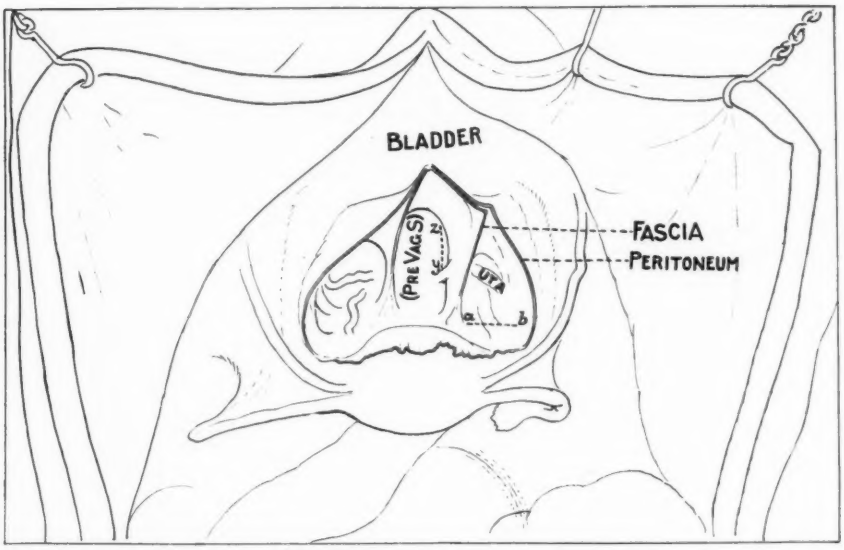



Fig. 18 shows the prevaginal space (Pv S) opened up and the lines of incision *y z* through the fascial lining of this space directly down upon the vaginal wall, below the uterine aretery, and *a b* through the loose cellular tissue of the broad ligament above the uterine artery down to the peritoneum. The former incision is for entering and opening up the fascia lined uretero-vaginal space (Figs. 19, 29, and 33, Uv S) whereby the vesical end of the ureter is raised from the side of the vagina, and the latter incision is for separating the posterior peritoneal fold of the broad ligament backward from the parametrium, thus effecting the retroparametrial opening (Fig. 19, Rp O). For technique see text of this figure. Ut A, uterine artery showing in relief through the fascia covering it.

the posterior wound. In Fig. 33 the opening *c d* through this fascia into the retrorectal space is made by incising a fold of the fascia raised from the sacrum with forceps. The fascia propria recti extends upward over the lower lumbar vertebræ and laterally it leads out to the ureters (Figs. 30 and 33) where they cross the iliac vessels, at the situation of which structures the pelvic retrointestinal plane of cleavage ceases. Thus, since the outer limits of this plane of cleavage become guides to the situation of the ureters, the freed peritoneal flaps can be severed internal to these limits without danger of injuring the urinary conduits. In operative technique it is not recommended, however, to sever the peritoneum too widely from the bowel, or there will not be enough of this structure left to bridge over the pelvic wound. Where the pelvic retrointestinal plane of cleavage opens down to the tip of the sacrum, then the fascia propria recti is seen to cover the structures (Fig. 32) of the great sacrosciatic notches and thence to be reflected over the lateral parametrial attachments of the rectum and vagina to the pelvic wall (Fig. 33 *g* and L S). The methods of entering the sacrosciatic spaces from above are described under Fig. 33. The fascia propria recti in lean subjects is fibrous and in fat subjects fatty in character; it supports the hypogastric plexus (H P) of the sympathetic and the nerve trunk passing off from it on either side to the pelvic plexus. These nerve trunks are guides to raising from their deep attachments the lateral peritoneal reflections of the cul-de-sac along the bowel (see Fig. 28). Also, if the fascia propria recti be delicate in structure and as a result be torn through into the retrorectal space over the upper portion of the sacrum, as may happen, thus complicating the finding of the pelvic retrointestinal plane of cleavage, then the locating of these nerve trunks in the fascia on either side by making them taut by traction on the hypogastric ganglion, and stripping in front of them, affords guidance to the proper plane of separation.

Fig. 19. See legend under key plate on opposite page.

The interior view of the grooved director pictured in Fig. 13 is here shown. The dotted line (*n o p*) shows where the peritoneum is to be cut to complete the lateral severance of the uterus, vagina, and rectum in this operation. The dotted line *q r* across the bowel to a point just external to the superior hæmorrhoidal vessels, indicates the site of section which gives opportunity to mobilize, by the method here proposed, the greatest possible amount of the proximal end of the gut. A higher division of the bowel than this would be preferable (see p. 179). *r s* is the site of tying the superior hæmorrhoidal vessels and *r t* is the line of proposed division of the mesosigmoid at its root for mobilization (see "A technique for the liberation of the sigmoid flexure" p. 181).

Fig. 26 shows the left common iliac vein passing obliquely across the body of the fifth lumbar vertebra (cf. Fig. 31) seen through an incision going through both the vascular bowel layer and the fascia propria recti underlying the latter, thereby entering directly the retrorectal space. Therefore, in dissecting alongside of the superior hæmorrhoidal artery to open the pelvic retrointestinal plane of cleavage, one should be careful not to carry the knife too deeply or the vein will be liable to be injured. Chalot (138) mentions the relation of the superior hæmorrhoidal vessels to the left common

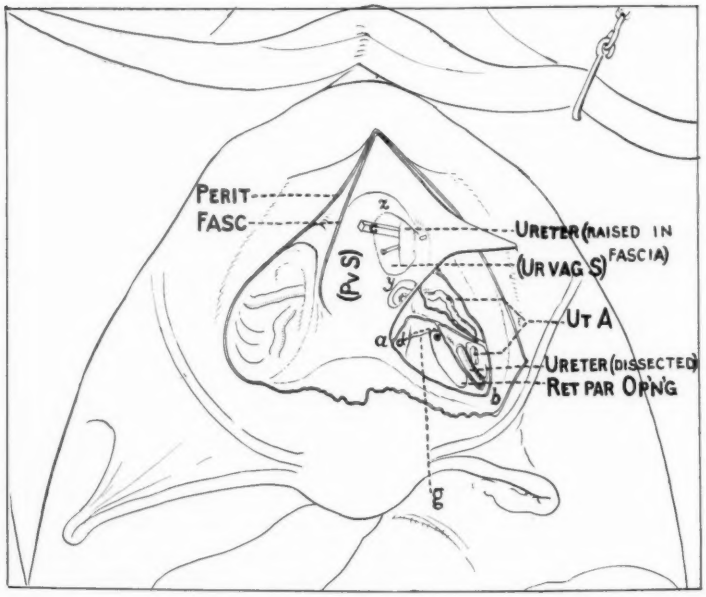



Fig. 19. Through the incisions *y z* and *a b* in Fig. 18, below and above the uterine artery respectively, cleavage of the tissues opens the uretero-vaginal space (Uv S) and the retroparametrial opening (Rp O), between which a portion of the parametrium is isolated. The inclination of the stick *c* indicates the direction of the plane of cleavage in opening the uretero-vaginal space. The ureter lying beneath the fascial lining of the latter space, is drawn into relief by the pin passed beneath it, while within the retroparametrial opening it is shown dissected free, through an incision in the fascial outer wall. Ut A, uterine artery exposed through an opening into the fascial plane in which it lies. *d e*, incision through the layer *g* (see Fig. 21) to enter a plane of cleavage (ureteral compartment of the parametrium, Ur C, Fig. 21), the opening of which raises the uterine artery in its fascial bed and separates the ureter in its sheath outward.

iliacs. In this dissection both the retrorectal space had been previously opened up, and the lower portion of the lateral sacral attachments of the fascia propria recti (Fig. 8 *l m*) torn loose, through a posterior wound. The firm upper portion (*l m'*) of this lateral sacral attachment which is fixed to the side of the body of the first sacral vertebra, is here seen raised from its normal apposition with the common iliac vein and swinging free.

Fig. 27 shows the completed lateral separation of the rectum, uterus, and vagina, and the sigmoid severed and mobilized, as indicated in Fig. 25. The ovarian artery and the artery of the round ligament have been tied and severed. The opening up of the plane of cleavage (lateral vesicovaginal space) between the side of the vagina and base of the bladder below the ureterovaginal space and the exposure here for ligature of a vascular fold connecting vagina and bladder, is shown in Fig. 31. The vagina has been opened into in front and then cut down on the side indicating the extent of its partial excision.

*The liberation of the sigmoid flexure.* The sigmoid is the portion of bowel which in excision of a high rectal growth, may be brought down to effect an anastomosis with the normal anus, or consequent upon the same operation or that of amputation of the rectum, is utilized in the making of an artificial anus. In either case it must be freed in part from its meso-connections, of which there are *two structures* which limit the distance to which the proximal end of the severed sigmoid can be carried, one the *entering vessels* and the other the *peritoneum.*

In dividing the *vessels of the mesosigmoid*, it would seem desirable that a systematic plan should be followed. Thus the nutrition of the

Fig. 20. See legend under key plate on opposite page.

liberated segment should be fostered by preserving the vascular arches in connection with the freed portion of bowel, as well as by dividing as few branches of arterial supply to the arches as possible. Kümmell (139) has advised mobilizing the mesentery to the farthest possible extent removed from the bowel, and Archibald (140) emphasizes the necessity of leaving the vascular arches in connection with the liberated bowel for preserving its nutrition. The loss of blood from the division of the very vascular mesosigmoid, which is liable to be considerable and consequently annoying, should be limited by isolating and tying each main vessel separately before cutting it. Chalot (141) demonstrated that the proper place to tie the superior hæmorrhoidal and sigmoidal vessels for the control of hæmorrhage was near their origins. Also the vessels should be divided at the proper anatomical site[1] to permit the spreading out of the base of the mesosigmoid so as to allow the bowel to straighten as much as possible. In Fig. 33 the main sigmoid artery divides near the root of the mesosigmoid into several branches which spread fan-like to supply the arterial arches of a considerable loop of bowel, and in Fig. 35 the main artery branches at intervals to supply the arches of a loop thirty inches in length. In either of these instances it can be seen that the severance of the main sigmoid trunk would not only not relieve the

[1] Since defining the proper anatomical site for division of the vessels of the mesosigmoid in the liberation of the sigmoid loop, the writer has had his theoretic proposition confirmed by Hofrat v. Kraske, who by a blackboard drawing demonstrated the fan-shape distribution of the vessels from the main sigmoid trunk, and presented the importance of tying each branch of the distribution distal to the main trunk and proximal to the arterial arches.

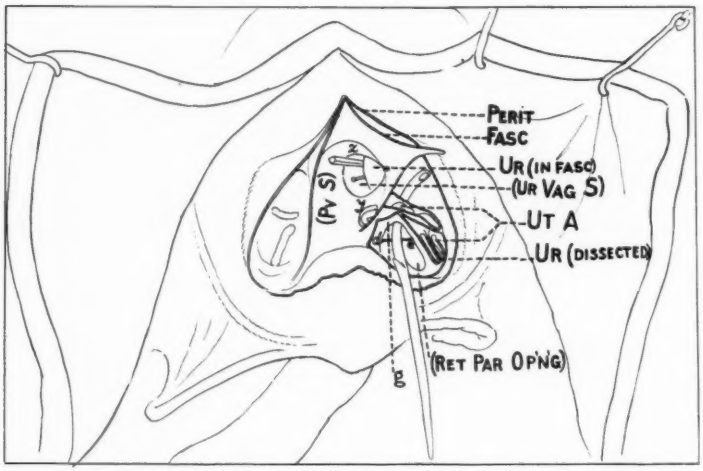



Fig. 20. A hook passed through the incision *d e*, Fig. 19, into the plane of cleavage (ureteral compartment of the parametrium, UR C, Fig. 21), beneath the fascia on which the uterine artery lies, and out through the latter fascia below the artery, catches up this vessel in its surrounding tissues. For technique of opening up the ureteral compartment of the parametrium see text of this figure.

constricting influence exercised on the base of the mesosigmoid by the converging vascular cords, but it would also endanger the nutrition of a large portion of so long a freed loop of bowel which could then receive blood only through the collateral circulation from the colica sinistra artery. Therefore, in cases like these it would seem a correct proposition to select for severance the branches of distribution which pass from the main trunk to the arterial arches, and not to interfere with the main trunk itself. Only as many of the lower branches should be divided as are necessary to gain the proper lengthening of the bowel. If an upper branch or two of the sigmoid artery can be left intact, this supply will remain an important source of nutrition to the freed segment. In Figs. 25 and 27 there are two separate sigmoid trunks which do not fork until the arterial arches are reached, so that in an instance of this sort the anatomical conditions would permit only of ligaturing the main trunks. Another type of arterial supply was found in a sigmoid having a long and narrow meso-attachment. In this case there was along the bowel loop one main arterial arch, and crossing the base of the mesosigmoid was an anastomosing artery which connected together opposite points of the arch at this situation. In order to attempt to straighten out this loop of bowel, the anastomosing vessel across the base of the mesosigmoid had to be divided as well as the peritoneal leaves cut radially, and then it was found impossible to let out much slack on account of the gathering influence exercised on the loop of bowel by a rather distant setting from it of the arterial arch.

The *peritoneum* should be cut on either side of the mesosigmoid in the lines of approach to the vessels for their ligature (see "a technique for the liberation of the sigmoid flexure," p. 181). It should not be included within the grasp of any ligature, since if thus tied it is gathered into folds, thereby shortening the liberated edges of the mesosigmoid, which it was the effort rather to lengthen. Where the bowel end, mobilized as here indicated, does not straighten out on account of the mesosigmoid having a narrowed base, additional length can be gained in the freed segment by making radiating incisions in the peritoneum beneath the vascular arches, in a line between any two entering branches, though with the support of the peritoneum too much interfered with there must be a greater liability of traction on the vessels and consequent tendency to interference with nutrition.

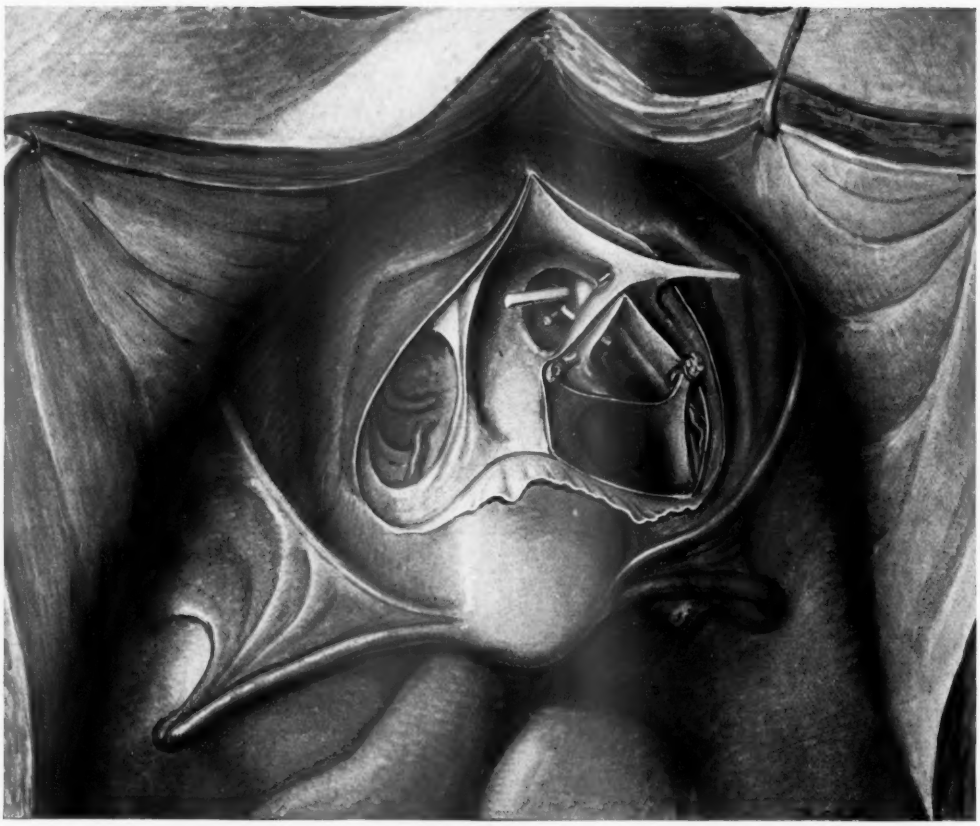


Fig. 21. See legend under key plate on opposite page.

As regards the *anatomical conditions under which it would be possible to lengthen the sigmoid sufficiently to bring it down to the anus* Ball (142) states, that if the mesosigmoid is about six inches (which is the "average greatest length" of the mesosigmoid) long, "the divided colon can be brought to the anus without undue tension. If, however, it proves to be considerably shorter than this limit, the case will probably have to be terminated in colotomy." To the writer it would seem that the length of bowel in the free sigmoid loop might be of even greater significance in this regard than is the length of the mesosigmoid. In observations on 25 cadavers, the mesosigmoid had a maximum length of but five inches which was found in only two instances, in all the other cases there having been a length of not over $3\frac{1}{2}$ inches. Furthermore, there seemed to exist no definite ratio between the lengths of the mesosigmoids and the lengths of the loops. A long mesosigmoid, which is at the same time narrow, may have the vessels in it so arranged as to materially interfere with the straightening out of the bowel (see p. 173). When a loop of sigmoid is short, as was that shown in Figs. 29 and 30, it certainly cannot be brought down to the anus. The sigmoid in this case and that shown in Fig. 28, which also had a short loop, were both bound down in the iliac fossa for their entire extent, a mesosigmoid existing only from the inner edge of

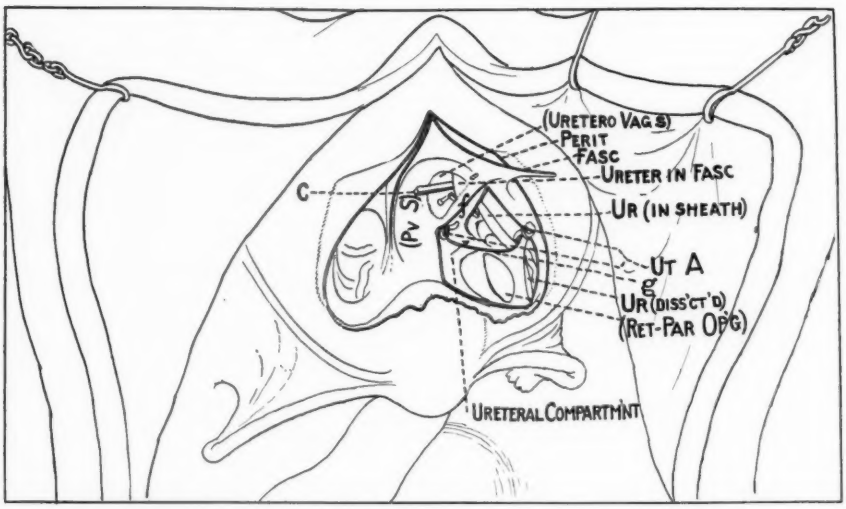



Fig. 21 shows the uterine artery, together with its fascial surroundings severed and the stumps (UT A) drawn apart, disclosing beneath a triangular area within the parametrium (ureteral compartment of the parametrium, UR C), at the outer side of which the ureter lying in its sheath comes plainly into view. In contradistinction the ureter in its relation to the uretero-vaginal space and the retroparametrial opening, located respectively in front of and behind the ureteral compartment of the parametrium, lies external to fascial walls, so that in these situations it does not come directly into view. *f*, fascia under which stick has been passed to be cut in freeing ureter. *g*, posterior fascial covering (reflection from fascia propria recti, see Fig. 33, *g*) of the ureteral compartment, joining below with the fascial floor of the uretero-vaginal space, and supporting sympathetic nerves to the vagina and bladder. The vaginal veins lie upon the lower portion of the fascial layer *g* (see Fig. 24, LT VAG VE).

the psoas muscle to the middle of the third sacral vertebra. In both of these cases the greatest length of the mesosigmoid was about 2½ inches. In Figs. 25 and 27, the proximal end of the divided sigmoid having a mesosigmoid of about four inches in length which was shrunken somewhat by preserving fluids and drying, with the amount of liberation shown, could be brought down to the fourth sacral foramen. Treves (143) found the site of greatest length of the mesosigmoid to average 3¼ inches. Another question for determination in this connection would seem to be *the distance to which the blood can be conducted beyond the source of its supply with free return circulation, through the large anastomosing vascular arches* accompanying the liberated bowel, which have been severed from their proximal and lower connections. In a medium sized dog, in an extremity of resected small intestine freed together with the vascular arches from its mesenteric attachment for about five inches, necessitating the ligature of one main entering vessel, the two or three inches adjacent to the circulation remained nourished while the distal two inches became distinctly gangrenous. Kümmell (144) believed that the sigmoid, when liberated, was more liable to undergo necrosis than was the portion of colon above, since, as he reasoned, the arterial branches entered this portion of the bowel "perpendicularly" forming "no marginal vessel," so that when the main sigmoid trunk was severed the "collateral branches" were "insufficient" to conduct the circulation. To contravert this proposition, Archibald (145) has demonstrated on the other hand that the channels of anastomosis in the mesosigmoid have a perfectly free communication with each other and with the marginal artery of the colon above. On a cadaver, after having first tied the superior hæmorrhoidal, sigmoid, and left colic arteries, he injected a starch solution into the aorta, and found that the injection penetrated freely from the middle colic artery above all the way down through the marginal vessels to the sigmoidorectal junction. At the

Fig. 22. See legend under key plate on opposite page.

latter site he also showed that the injection was liable to become arrested or to penetrate only slightly beyond, thus demonstrating a poor collateral circulation between the sigmoid and superior hæmorrhoidal systems of vessels; wherefore he reasons that section of the bowel end should always be made sufficiently above this level to be at a site of free arterial anastomosis, where one could have greater assurance of getting a well-nourished stump. He proposes division of the sigmoid loop anyway not below the level of the promontory, for the purpose of effecting a wide removal of tissue, which site would thus also be above the area of poorer blood supply, the actual height of section depending on the palpable height of invasion of the mesosigmoid. Archibald is of the opinion that the section of the sigmoid flexure too near the rectum has been a frequent contributory cause in the production of necrosis of the proximal bowel end brought down in the removal of the rectum by the sacral route. Moynihan[1] (146) states that the tying of the inferior mesenteric artery close to the aorta above the site of giving off the left colic branch does not impair the circulation in the colon down to a point of high division of the sigmoid. It still remains to be demonstrated in just how long a segment of liberated colon, the *vis a tergo* of the cardiac impulse is able to drive the blood through the bordering arterial arches to the ultimate ramifications of the distributing vessels on the bowel walls (see liberation of the transverse and descending portions of the colon, p. 185).

In cases of rectal resection without division of the superior hæmorrhoidal artery, Rehn (147) has cautioned against the danger of kinking at an angle the inferior mesenteric artery at its origin by traction on the drawn down proximal extremity of bowel. The writer

[1] *Ibid.*

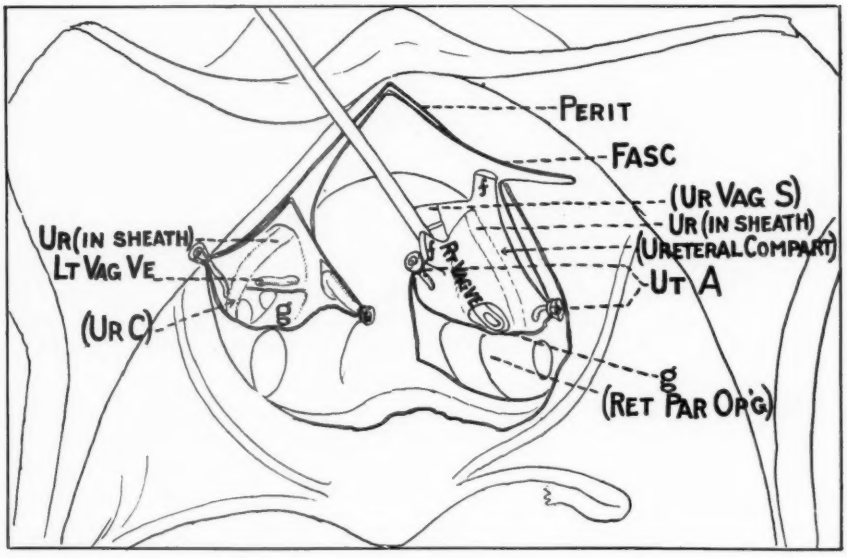



Fig. 22. On the left side the dissection of the ureteral compartment (UR C) of the parametrium is similar to that on the right side in Fig. 21. A vaginal vein (LT VAG VE) is seen on this side. On the right side the hook is made to puncture through the floor of the uretero-vaginal space, passing into the space below made by the operation through the posterior wound (see Fig. 23), and raises the tissue RT VAG VE, which contains the vaginal veins and the fascial floor *g* (Fig. 21) on which they lie. // , severed ends of tissue beneath which the stick was passed in Fig. 21.

finds, however, that the inferior mesenteric artery leaves the aorta at an acute angle opening downward, so that whatever else traction might do to the vessel it could not kink it.

*As to the amount of elongation of a sigmoid loop necessary for the performance of a low sigmoidorectal anastomosis*, it was found that in an adult male cadaver, when the cut edge of the mesosigmoid containing the vascular arches attached to the freed loop of bowel could be drawn down 5½ inches over the left common iliac artery, then the extremity of the gut just reached to the upper margin of the internal sphincter without tension. Therefore, the proximal sigmoid extremity must be capable of about 5½ to 6 inches descent into the pelvis below the left common iliac vessels to effect the anastomosis.

### STUDIES OF THE SIGMOID COLON

With a view of getting some definite idea of the anatomical variations affecting the sigmoid colon, which seemed to be numerous, the writer made a study of this segment of bowel in 25 subjects in the dissecting-room.

*Length of the mesosigmoid.* In the 25 cases but two of the sigmoids had a meso-attachment as long as five inches at the site of greatest length. Eighteen were between 2 and 3½ inches at the site of greatest length and the rest less than 2 inches. Of the latter, 1 case had no mesosigmoid at all, being bound down to the iliac fossa and wall of the true pelvis for its entire extent, and another took a very *anomalous course*, it crossing the left psoas opposite the fifth lumbar vertebra, thence running upward in a line an inch above and parallel with the left common iliac artery, crossing the bifurcation of the aorta, thence passing downward along the right common iliac where it lay in the root of the mesentery of the lower ilium, and finally dipping over the right side of the brim into the true pelvis. Where it ran parallel to the left common iliac artery and corresponding to its course in the true pelvis it had a meso-attachment about

Fig. 23. See legend under key plate on opposite page.

1½ inches in length. The *transverse measurement* of this sigmoid laid flat was only ⅞ of an inch. The transverse measurement of 8 of the sigmoids was from ¾ to 1¼ inches; of 14 from 1½ to 2 inches; and of 1, 2½ inches.

*Length of the free sigmoid loop.* In the 23 cases, each of which had a free loop of bowel, the loops varied from about 4 inches to about 30 inches in length. In 7 cases the loops were from about 4 to 7 inches in length; in 13 cases the loops were from about 10 to 18 inches in length; and in 3 cases they were from 26 to 30 inches in length. *The sites of attachment of the mesosigmoids to the pelvic wall* were of interest. In only two of the 23 cases having a free loop of bowel was there a meso-attachment of the sigmoid for its entire length from the crest of the ilium to the third sacral vertebra. One of these had the main portion of the loop in the iliac fossa, and the other in the true pelvis. The most usual finding (16 cases) was, that the line of pelvic meso-attachment coresponding to the free loop of sigmoid was either limited to the front of the psoas muscle or else it ran between the psoas muscle and the third sacral vertebra, the remainder of the sigmoid having a close attachment to the iliac fossa (see Figs. 28 and 29). In these cases the sigmoid loop would drop entirely over the brim and be found hanging in the true pelvis. Two cases had a close attachment of the sigmoid across the psoas and a meso-attachment above and below this muscle; another case had a meso-attachment corresponding to the iliac fossa and front of the psoas muscle with a close attachment of the sigmoid below the brim; and in the remaining case the meso-attachment was so thick and solid with fat that it practically immobilized the attached bowel. In two of the three cases having the longest loops of free sigmoid (26 to 30 inches), the site of attachment of the meso-sigmoid was from the inner margin of the psoas across to the promontory and thence downward to the third sacral vertebra, and in the other case the mesosigmoid was attached similarly except its line of attachment ran a little higher up, to the outer margin of the psoas. Treves (148) found that the most usual site of attachment of the mesosigmoid was from the outer border of the psoas to the third sacral vertebra, and that the normal position of the

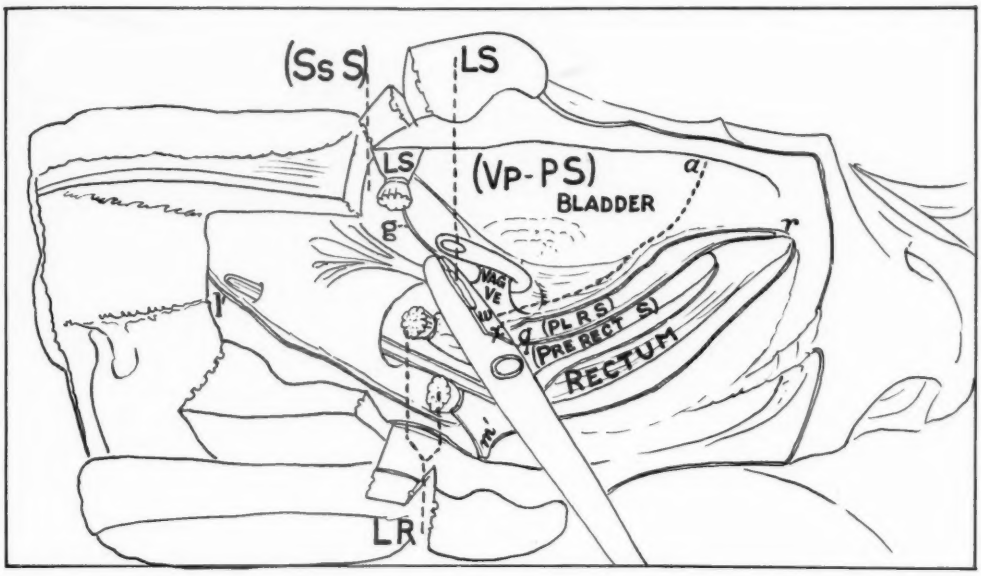



Fig. 23. The hook in Fig. 22 picking up the tissue R1 VAG VE, containing the vaginal veins and the underlying portion of the fascia *g*, is here seen as it passes through the vesicoparametrio-pelvic space (VP-P S) opened up by the operation below. It is situated close to the vaginal wall, leaving the ureter with its accompanying inferior vesical vessels externally (cf. Figs. 17 and 33, VAG VE). The ureter and the inferior vesical vessels here lie under cover of fat extending backward from that covering the side of the bladder. The lines of section between the stumps L R, L R, and into the prerectal space (PR S), employed in close local excision of the rectum alone, are shown in comparison with those between the stumps L S, L S, and at the site (hook) of tying the tissue (VAG VE) containing the vaginal veins, employed in wide local excision of the rectum, uterus, and part of the vagina. *w a*, line corresponding to situation of posterior border of parametrium, which has been split off from its attachment to the white line. *g*, same as in Fig. 21.

corresponding loop of bowel was "not in the left iliac fossa but wholly in the pelvis."

*The practical lessons* to be deduced are: That in cases of certain anomalies in the course of the sigmoid, or of absence of the mesosigmoid which signifies concomitant absence of loop, or where the loop of free sigmoid is short, it would be impossible to draw the proximal end of the bowel down for anastomosis with the distal segment; That the mesosigmoid is, as a rule, comparatively short; That the free loop of sigmoid in 64 per cent of the cases was 10 inches or more in length and in 36 per cent was not over 7 inches in length; That the variations of the caliber of the sigmoid might be a matter for consideration in contemplated anastomosis of the bowel ends; That in making a left inguinal colostomy, if the sigmoid is found to be bound down in the iliac fossa, a free loop of it should be sought for hanging over the brim in the true pelvis (found in 64 per cent of the cases); That the desirability of determining primarily the conditions affecting the sigmoid furnishes another argument in favor of commencing the operation of excision of high rectal cancer from above. From these observations one must conclude that in a certain number of cases end-to-end union following excision of the rectum would be an anatomical impossibility and consequently that an artificial anus must then of necessity be made.

*A technique for the liberation of the sigmoid flexure.* The writer proposes a technique of freeing the sigmoid, which varies with the anatomical conditions present. There are *three different anatomical conditions* affecting the attachments of the sigmoid colon which must be taken into consideration in this connection, one where the mesosigmoid has its site of attachment confined to the iliac fossa;

Fig. 24. See legend under key plate on opposite page.

another where the attachment of the mesosigmoid is limited to the wall of the true pelvis; and the third where the mesosigmoid is either very short or altogether absent.

1. Where the mesosigmoid has a site of attachment in the iliac fossa, divide its left peritoneal leaf along the site of reflection onto the iliac fossa, and then with the fingers passed through this opening, raise out of the fossa the retroperitoneal layer of fascia supporting the vessels of supply to the sigmoid, leaving behind the ureter in its fascial plane. Determine through this plane of cleavage the arrangement of the vessels of the mesosigmoid, which with traction on the bowel can be felt as cords. Then, beginning at the lower portion of the mesosigmoid, isolate as many as necessary of those vessels which go to form the arterial arches along the bowel, by pushing a finger through the tissues between them, after having first incised the right peritoneal leaf in the line of proposed isolation of the vessels. Tie the vessels thus isolated, each with two ligatures, between which cut across the mesosigmoid, thus freeing the bowel with its vascular arches attached.

2. Where the site of attachment of the mesosigmoid is limited to the wall of the true pelvis (Figs. 29 and 30) — the portion of the sigmoid above in the iliac fossa being more or less closely attached — the vessels to be divided can be best reached directly between the peritoneal leaves of the sigmoid. The severance of the left peritoneal attachment of the sigmoid

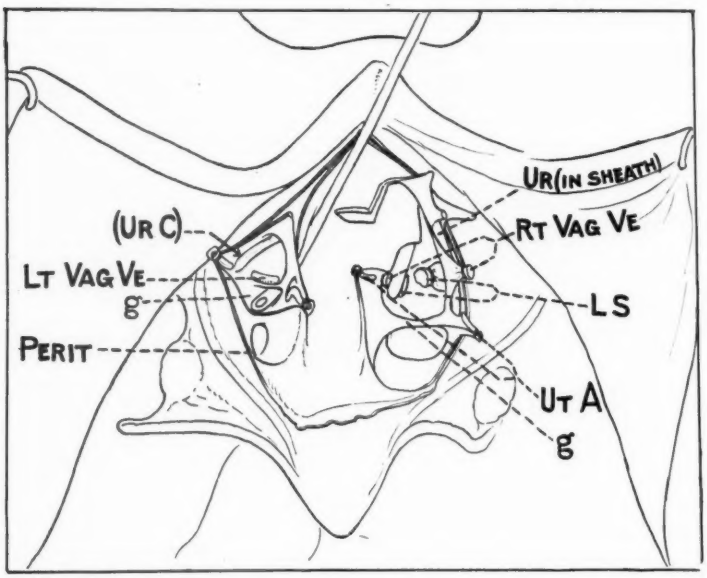



Fig. 24. On the right side the tissue RT VAG VE, Fig., 22 has been severed (stumps RT VAG VE), disclosing in the space below, the stumps (L S) containing the arteries and nerves entering the rectum and vagina laterally, which were severed at the pelvic wall through the posterior wound (Fig. 16). On the left side the hook raises the tissue (LT VAG VE) containing the vaginal veins lying within the ureteral compartment (UR C) of the parametrium. The lines of section of the vagina anteriorly and laterally are indicated.

in the iliac fossa in such a case, with simple stripping up of the layer of vascular supply out of the fossa, can then be practiced besides, to gain the additional amount of descent of the bowel into the pelvic cavity which this manœuvre affords. A peritoneal attachment of the left leaf of the mesosigmoid at the brim causes particular restraint.

3. Where the mesosigmoid is either very short or altogether absent sufficient of the bowel can be freed for the making of an artificial anus by raising the bowel out of the iliac fossa, after having divided the peritoneal attachment on either side, and then dividing the vessels of supply proximal to the arches, which latter are present with this anatomical arrangement of the gut just the same, though extraperitoneal and receiving blood from correspondingly shorter branches. The writer has successfully practiced this latter technique in the making of a permanent inguinal colostomy on a patient with inoperable cancer of the rectum who was suffering from a beginning intestinal obstruction, where the sigmoid, having a meso-attachment of not over one inch at its site of greatest length, was raised free for full five inches, then was brought through the abdominal wall and turned upward between the aponeurosis of the external oblique and the skin for two inches without any disturbance of its nutrition.

In all cases the bowel should be preferably severed with a cautery between clamps or between two stout ligatures tied around a crushed area (Doyen (149), opposite to which site of section both peritoneal folds should be cut across to their bases to expose beneath them the vascular arches, which in turn should be isolated and tied and then cut. In raising out of the iliac fossa the fascial layer supporting the vessels of supply to the sigmoid, care should be taken not to injure the ureter which lies in a separate layer of fascia posteriorly, between which and the former layer is found the plane of cleavage.

Applicable to the *freeing of the sigmoid* under

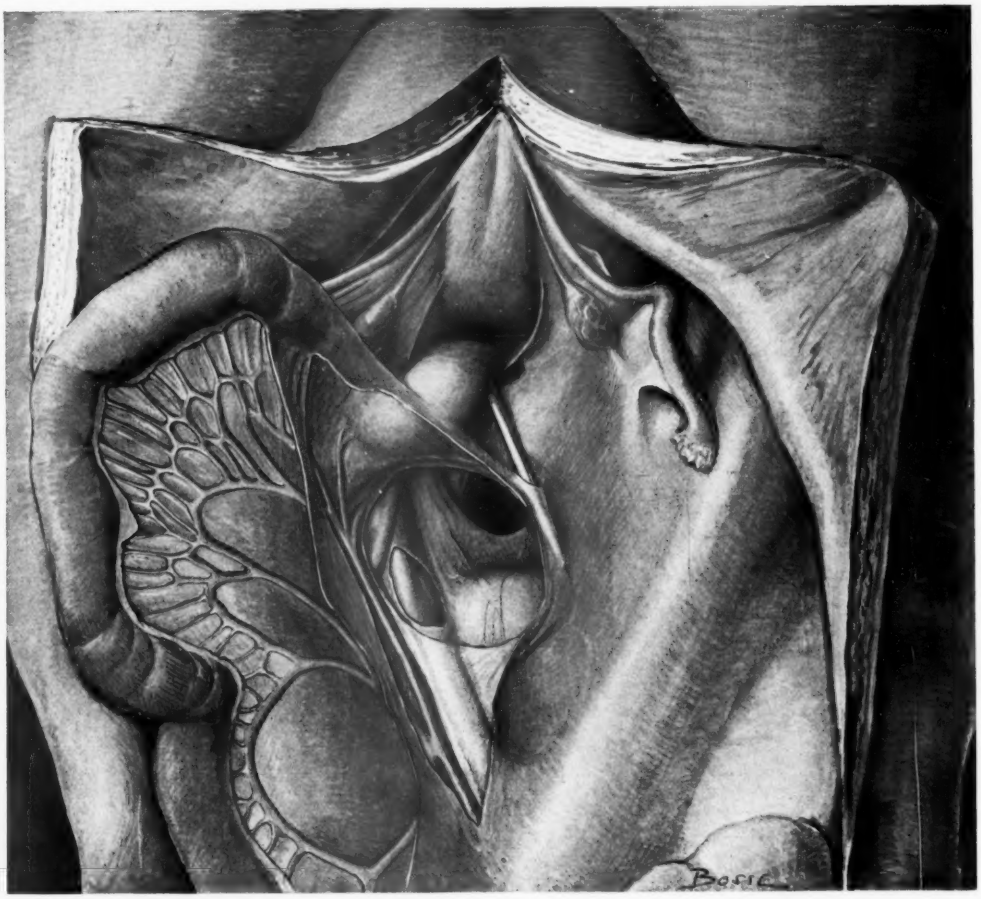


Fig. 25. See legend under key plate on opposite page.

any of the above anatomical conditions are here summarized the *following general principles* which have been already enunciated: Leave the vascular arches intact adjoining the freed portion of the bowel. Where a sigmoid artery divides into branches which diverge fan-like (Fig. 33) or are given off at intervals (Fig. 35) to supply the arterial arches, it is these branches and not the main trunk which should be severed (see note, p. 174) so as to allow the bowel to straighten out, and only as many as are necessary of the lower of these branches are cut in order to preserve, if possible, some of the circulation from the sigmoid artery through the upper channels of distribution. Do not include the peritoneum within the grasp of any ligatures, since the latter would then pucker the edge of the divided mesosigmoid, thereby interfering with the straightening out of the bowel. Where the peritoneal leaves at the base of a severed mesosigmoid are so narrowed as to prevent the straightening out of the bowel, radiating incisions can be made in the peritoneum beneath the arches to lessen this restraint. To effect a low sigmoidorectal anastomosis, the proximal sigmoid extremity

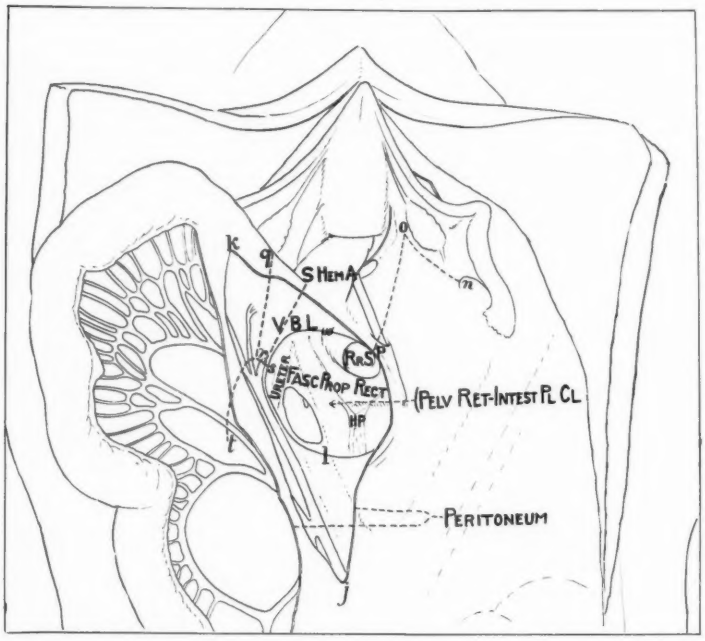



Fig. 25 indicates an anatomical method of cleaving the rectum and adjoining portion of the sigmoid from their posterior attachments, and shows the arterial supply to the sigmoid. Owing to the dissection below, the upward and forward traction on the uterus draws the bowel away from the sacrum. The lines of operative incision are *j k*, through the peritoneum to expose the superior hemorrhoidal artery (S HEM A) lying on the vascular bowel layer (V B L), and *l w*, through the latter layer to the right of the superior hemorrhoidal artery to enter the pelvic retrointestinal plane of cleavage (PELV RET-INTEST PL CL), which lies between the vascular bowel layer and the fascia propria recti (FASC P R). This plane of cleavage here terminates below about opposite the middle of the sacrum by the union of the lwo layers (for usual condition cf. Fig. 33). The mesial opening in the fascia propria recti leads into the retrorectal space (RR S). H P, hypogastric plexus of the sympathetic lying in the fascia propria recti in front of the fifth lumbar vertebra, from which a nerve trunk passes off on either side to the pelvic plexus. The left ureter is exposed where it crosses the iliac vessels at the lateral limit of the pelvic retrointestinal plane of cleavage. The internal iliac artery can be exposed by dividing the fascia propria recti which covers it. A window has been made in the right peritoneal leaf of the mesosigmoid to lay bare the arterial distribution. *q r*, line of division of the bowel and mesosigmoid, including the adjacent vascular arch (a higher division is preferable). *r s*, line of division of the superior hemorrhoidal vessels, and *r t*, of the mesosigmoid at its root, here cutting off the arterial supply of two main trunks. *n o p*, peritoneal incision for completion of the lateral severance. The position within the peritoneal cavity of the director in Fig. 13 is here shown.

must be capable of about 5½ to 6 inches descent into the pelvis below the left common iliac vessels.

*The liberation of the descending and transverse portions of the colon.* High liberation of the colon has been practiced in rectal excision where the sigmoid was involved in the disease or was the seat of an artificial anus, for the purpose of securing descent of the proximal extremity of bowel for a pelvic exit or anastomosis.

Treves (150) excised successfully the descending colon, sigmoid, rectum, and anus, dividing the bowel at the splenic flexure and bringing the transverse colon into the perineal wound. Kümmell (151) reported two successful cases. In one the "upper third of the descending colon" was implanted in the anus, and in the other the transverse colon was implanted in the anus. In the latter case intestinal obstruction supervened after six weeks, which was relieved by freeing two coils of small intestine which were found kinked and adherent in the true pelvis. De Quervain (152) cut the colon at the splenic flexure and anastomosed the transverse colon with the rectum

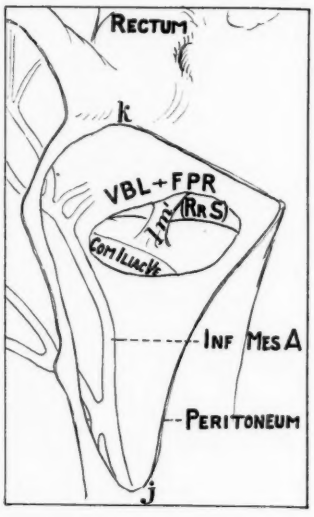



Fig. 26 shows the relations of the left common iliac vein crossing the body of the fifth lumbar vertebra, injury to which should be guarded against. This vessel is seen through an incision going through both the vascular bowel layer (V B L) and the fascia propria recti (F P R) underlying it, thereby entering directly the retrorectal space (RR S). The retrorectal space had previously been opened up and the delicate lower portions of the lateral sacral attachments (Fig. 8, *l m*) of the fascia propria recti up to the first sacral vertebra torn free, through a posterior wound. The firm upper portion of the left lateral sacral attachment (*l m'*) of the fascia propria recti to the first sacral vertebra is raised from its normal apposition with the common iliac vein and drawn to the right.

by suturing from without the anus the invaginated ends. Necrosis at the seat of anastomosis followed, which De Quervain believed took place in the distal segment. Later, intestinal obstruction developed and operation demonstrated the liberated portion of colon lying to the right of the mesentery and crossing the ilium near its terminal portion, which latter became kinked and adherent to the right of the colon, forming the seat of the obstruction. De Quervain therefore recommends suturing the liberated colon to the posterior parietes. Archibald (153) implanted the descending colon in the anal canal. The patient died in twelve hours, but "the post-mortem showed no sign of a failure of circulation in the bowel brought down." Moynihan[1] practices liberation of the descending colon and spleenic flexure in order to bring the bowel ends together for anastomosis following high division of the sigmoid flexure (see p. 132). The

[1] *Ibid.*

principle set forth in these operations for liberating the descending and transverse portions of the colon is to leave intact the vascular arches in connecton with the freed bowel, tying off the entering trunks.

*Technique of liberating the descending and transverse portions of the colon.* The writer proposes the following technique, based on anatomical study, for liberating these portions of bowel: Make an oblique incision in the left flank beginning at the tip of the eleventh rib, passing downward and forward toward a point on Poupart's ligament of the opposite side corresponding to the junction of its outer fourth with its middle two-fourths, and terminating just after having cut through the left linea semilunaris. This incision divides the abdominal wall between the tenth and eleventh dorsal nerve trunks, opens directly down upon the descending colon and splenic flexure, and affords as direct access as can be gotten by any approach to the attachments of the adjoining portion of the transverse colon. Raising the hips so as to flex the lumbar spine gives a higher reach through this incision. Snip with scissors the peritoneum along the outer side of the descending colon and raise the latter with its vascular connections inward. The descending colon measured from the splenic flexure to the crest of the ilium, when detached, is only about five inches long and little descent of it can be gained even by cutting its vascular connections unless the splenic flexure is mobilized as well. To mobilize the splenic flexure, first draw the flexure forward and cut its posterior peritoneal reflection passing over the lower pole of the kidney, also extraperitoneally in this same locality cut a fascial connection of the bowel. Then sever the phrenicocolic ligament, access to which is facilitated by first dividing the near-lying portion of the gastrocolic omentum and opening into the lesser peritoneal cavity, which exposes the upper surface of the transverse mesocolon. To detach the transverse mesocolon, first split off with the knife handle its peritoneal folds above and below and cut them, and then isolate the entering vessels and tie them as close as possible to the root of the attachment. A large vessel may be found descending from above to the bowel near the phrenicocolic ligament, and an ascending branch of the left colic artery to the splenic flexure is sometimes met. In carrying out this technique of mobilization, it will be found that but little of the transverse mesocolon at a time can be reached for severance through this flank incision, but with each division of this structure, sufficient of the next deeper unsevered portion can always be drawn out into the wound for manipulation, until finally the proper amount of mobilization has been secured, which should be up to a point a little to the left of the middle colic artery. The detachment of the gastrocolic omentum should be carried simultaneously as far as to the right limit of the lesser peritoneal cavity. It is a significant fact that the middle colic artery at its origin from the superior mesenteric passes upward through firm connective tissue, so that as the bowel, freed distal to the site of entrance of this vessel, is drawn downward, this entering artery thus supported, does not tend to kink but rather to describe a moderate curve in the direction of the bowel. To make a good rearrangement of the liberated bowel within the peritoneal cavity, it seemed best that it should be brought around to the left of the duodenojejunal junction and laid against the posterior abdominal wall over the site from which the excised portion of the bowel was removed. By this disposition the bowel would be placed in a situation in which it could not become the cause of intestinal obstruction and where it would aid in covering over the exposed surface of the abdominal wall. It certainly would seem advisable, in the light of the experiences cited, to suture the freed segment of bowel in this new position, as recommended by De Quervain. It has seemed to the writer from anatomical observation that, in order to get a sufficient length of bowel from this locality to reach down to the normal anus without tension and occupy the course just specified, the liberated segment must include the entire splenic flexure.

*The completion of the technique of operation II.* The peritoneal flaps can be brought together so as to form a diaphragm over the upper portion of the pelvic cavity, provided the peritoneum has not been cut too widely along the sides of the bowel. The chief flap is the anterior one associated with the bladder.

Fig. 27. See legend under key plate on opposite page.

The separated mass can be drawn out and removed through the lower wound. In view of the fact that the whole peripheral detachment of the rectum can be done from above through an abdominal incision (operations III and IV), with the ability to clamp off the bowel thus freed distal to the disease, below through the vagina, the only real indication for the posterior wound in operating for high-seated cancer of the rectum, would then be for the performance through it of circular suture of the bowel ends.

III. *Wide local excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor, entirely by the abdominal route (Figs. 28 to 32).

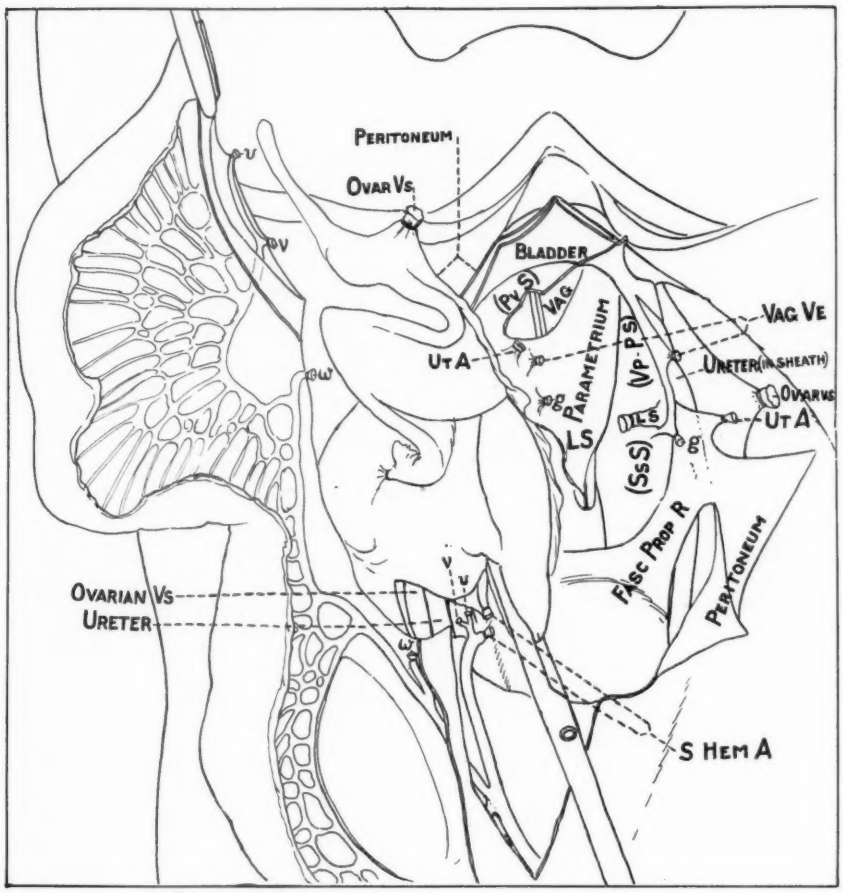



Fig. 27 shows the completed lateral separation of the rectum, uterus, and vagina by division of the peritoneum along the line *n o p* in Fig. 25, and the sigmoid severed and mobilized in accordance with the proposition indicated in the same figure. The cut stumps (*u v w*) of the arteries of the sigmoid are lettered to correspond. L S, L S, stumps of parametrial tissue containing the arteries and nerves entering the rectum and vagina laterally, split off below the inferior vesical vessels and severed at the pelvic wall through the posterior wound (cf. Fig. 23, L S). Ov Vs, ovarian vessels. The lines of incision into the vagina (VAG) indicate the extent of its partial excision.

The abdominal route has practically become the one of general acceptance for primary approach in excision of high-seated cancer of the rectum. It is of decided advantage for determining at the very beginning of the operation the extent of the involvement by the disease, and, depending thereon, the operability of the case; also it facilitates ligature of the superior hæmorrhoidal vessels, and enables one to determine the particular anatomy of the sigmoid flexure and then to handle the same properly. That the rectum, uterus, and adjacent part of the vagina can all be enucleated together in one mass down to the pelvic floor through the abdominal route, makes it possible, unless the anus require excision, or a circular suture of the bowel ends above the sphincters be performed, to utilize this route alone for practically the entire operation, thereby eliminating the time-expenditure for making a posterior wound.

Fig. 28. See legend under key plate on opposite page.

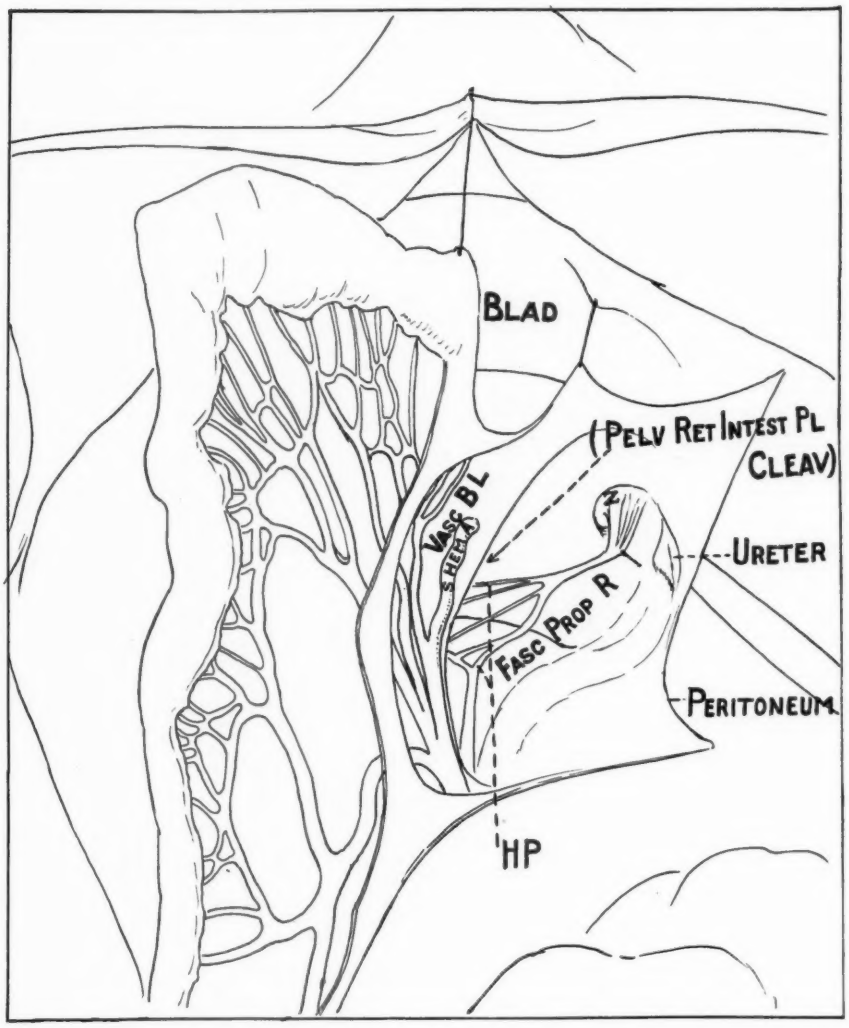



Fig. 28. Male pelvis showing pelvic retrointestinal plane of cleavage (text, Fig. 25) opened up and the hypogastric plexus (H P) of the sympathetic and the nerve trunk running off from it on the right side, dissected out of the fascia propria recti. *z*, opening (superior recess) made by blunt force anterior to the sympathetic nerve branches, raising the lateral peritoneal reflection onto the bowel off from the underlying tissues. In the female a similar procedure raises the peritoneum off from the parametrium forward to the retroparametrial opening (Fig. 19, Rp O). V B L, vascular bowel layer. Ureter raised on knife handle shows at brim, at the right lateral limit of the pelvic retrointestinal plane of cleavage. Here the site of attachment of the mesosigmoid is limited to the true pelvis.

In the fourth operative proposition, the demonstration of the possibility of removing the extraparametrial glands and fat (Fig. 34) by the abdominal route, would seem to supplement the other advantages of this route by a quite conclusive argument. In view of the fact that lymphatics of the anus drain both laterally through the middle hæmorrhoidal trunks into

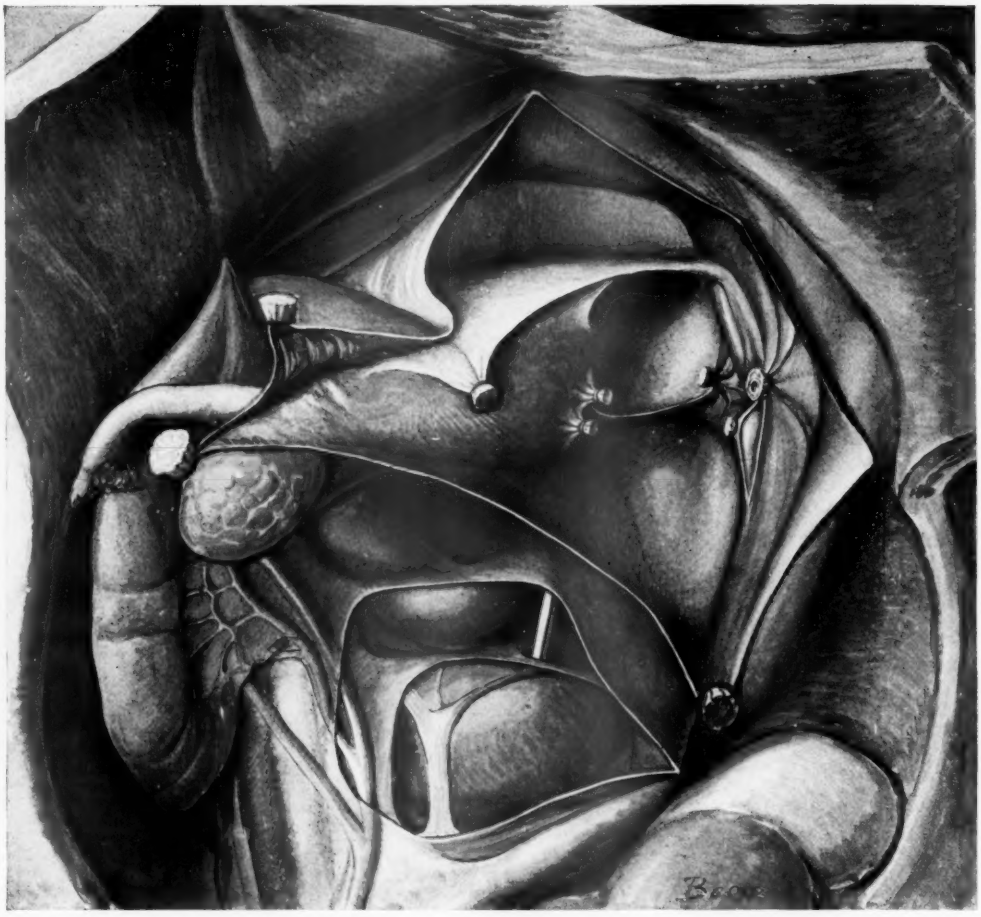


Fig 29. See legend under key plate on opposite page.

the external iliac glands and upward through the superior hæmorrhoidal trunks (see "The Lymphatics," p. 134), approach also to low-seated cancer primarily through the abdominal route in order to secure a wider removal of tissue, would seem to the writer a proposition for serious consideration.

The illustrations of this third proposed operative procedure and those of the fourth demonstrate from above, without any preliminary dissection having been made from below, the attachments and planes of cleavage of the parametrial tissues, a knowledge of which is essential in establishing a method for their wide removal. It might, therefore, be instructive at this time to summarize these *sites of attachment and planes of cleavage of the parametrial tissues* with a view of determining the sites for their detachment in operative work.

*The parametrium.* The parametrium is essentially a quadrilaterally shaped layer of tissue carrying branches from the internal iliac vessels and the third and fourth sacral and the sympathetic nerves, inward, to the lateral surfaces of the rectum, uterus, vagina, and bladder, and supporting the ureter in its fibrous sheath

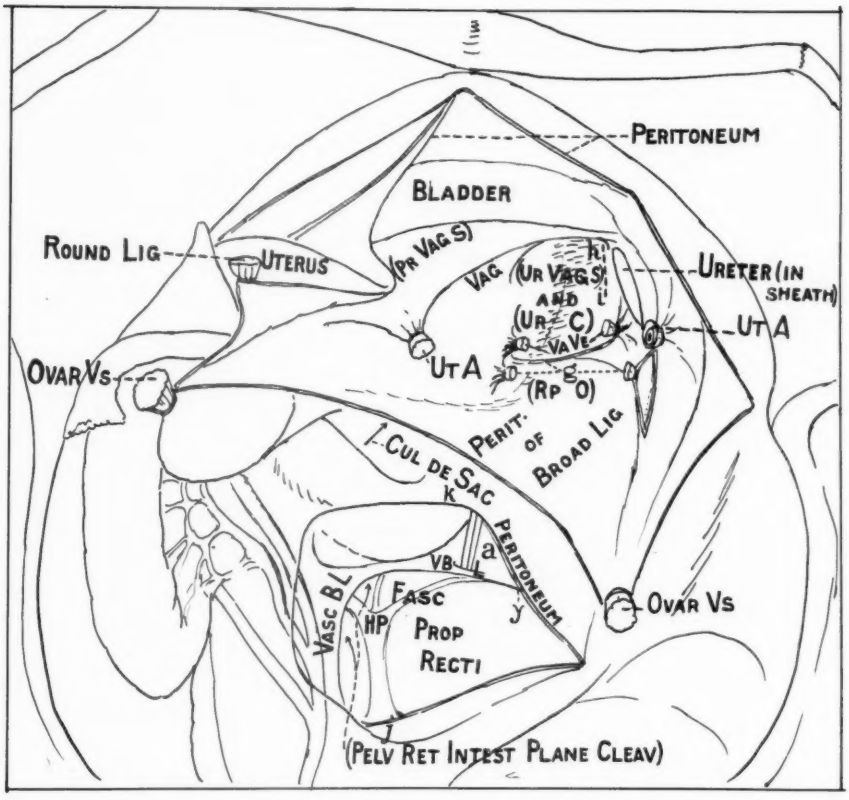



Fig. 29 shows the approach through the peritoneal incision *j k* to the pelvic retrointestinal plane of cleavage (see text, Fig. 25), and that to the deeper structures of the right parametrium below the level of the ureter. *a*, prismatic space formed by raising the peritoneum alongside of bowel from the vascular bowel layer (V B L), opened up to show the site of fusion *y*, of these two layers Va Ve, tied vaginal veins. *g*, posterior fascial covering of the ureteral compartment of the parametrium, partly tied off and severed. The uretero-vaginal space (Ur Vag S) and the ureteral compartment of the parametrium (Ur C) after raising and tying the vaginal veins, here seemed to present one continuous fascial floor (cf. Fig. 33). *h i*, is the location of the incision at the outer part of the fibrous floor of the uretero-vaginal space, where entrance is to be effected for completing the encirclement beneath the lateral parametrial attachment of the rectum and vagina to the pelvic wall (Fig. 30, hook 2). Through *h i* the lateral vesicovaginal space (Fig. 31, L Vv S) is also reached. Rp O, retroparametrial opening, in the bottom of which the finger passed from behind along the front of the sympathetic nerve trunk (Fig. 28, supr. recess) can be made to appear, whereby the peritoneum at the side of the cul-de-sac is raised from the parametrium in a line for its division.

from the point where it leaves the internal iliac artery to its site of termination in the bladder. The *superior border* of this layer must, from the entrance of the vessels and nerves at this situation, be firmly attached to the pelvic wall, and its *inner surface* which distributes the vessels and nerves to the centrally located viscera, must also be firmly connected to these organs. The anatomical composition of the superior portion of the parametrium with the arrangement of the entering structures is described in the text of Fig. 12. The *outer surface* of the parametrial layer has a delicate fascial connection with the externally lying glandulo-fatty contents of the vesico-parametriopelvic space (see Fig. 34 and text of same), from which it is easily stripped off in opening up the space. Utilization is made of

Fig. 30 shows the pelvic retrointestinal plane of cleavage (P Ri P C) opened up (see text, Fig. 25), also the tissue (L S) containing the arteries and nerves entering the rectum and vagina laterally isolated out at the pelvic wall (hook 2, and see text, Fig. 29) and the bowel severed and the sigmoid mobilized in the manner already described (Fig. 27). Through the incision *h i* in the fascial floor of the uretero-vaginal space (Fig. 29) the cut edge of a deeper layer *e* beneath it is seen, which is the firm fibrous layer supporting the vessels going from the side wall of the pelvis to the rectum, vagina,

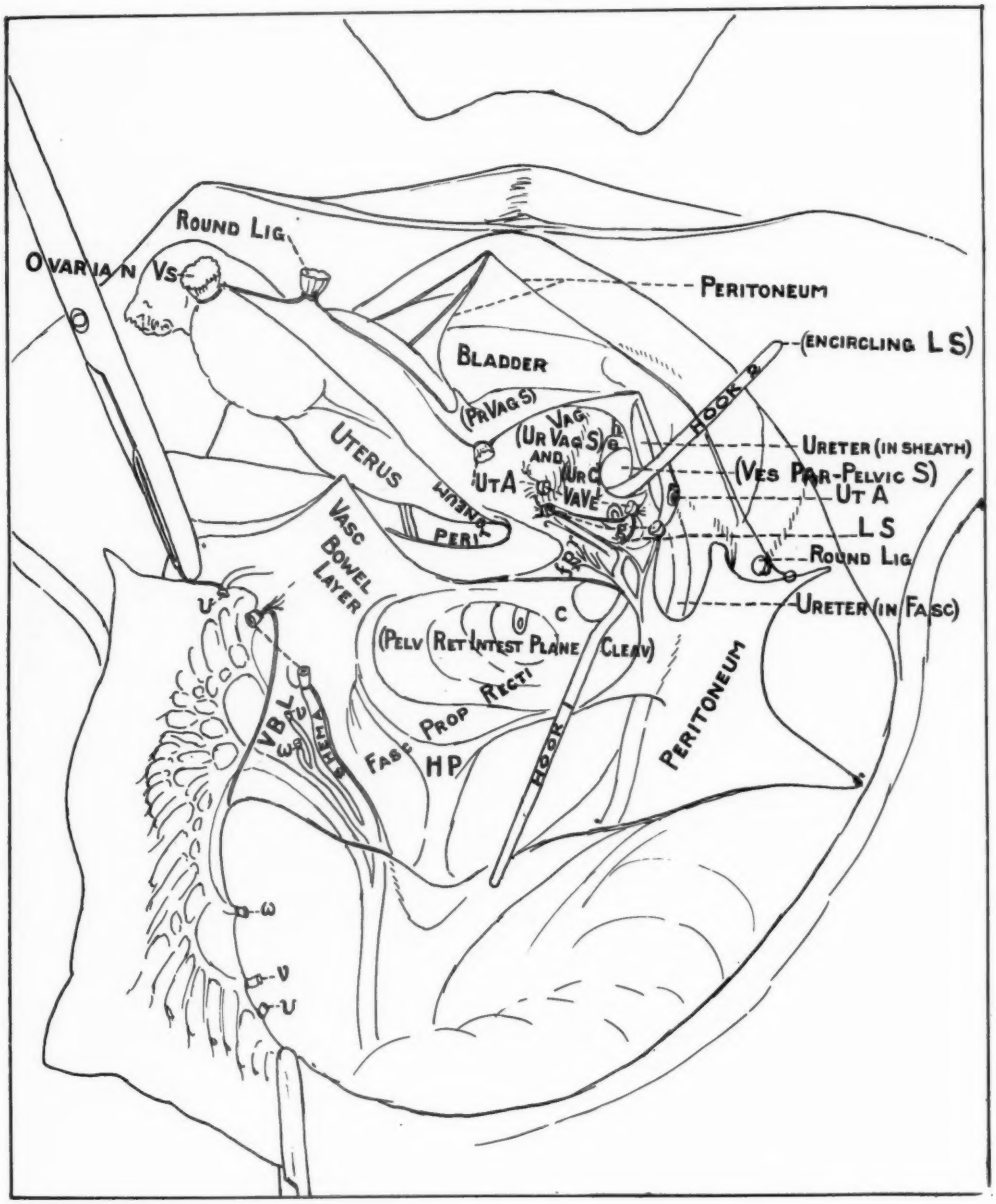



Fig. 30, *continued.*

and bladder. Through the opening in *e* the vesicoparametrio-pelvic space (Fig. 34) is entered, and the spine of the ischium is reached by the finger directed straight backward. From within the space backward pressure over the spine of the ischium penetrates into the postero-lateral rectal space (infr. recess, Fig. 33) thus completing the encirclement of the lateral pelvic wall attachment (L S) (inferior vesical vessels not here included, cf. Fig. 33, hook 1). Hook 1 raises

Fig. 30, *continued.*

from the top of the laterally isolated mass a reflection from the fascia propria recti (*f p r*) which supports branches of the sympathetic nerve and was here cut independently of the deeper portion of the mass. The remainder of this laterally attached isolated mass, beneath which the hook 2 has been passed, with the exception of the anomalous fascial slip *c* attached to the second sacral vertebra, was then severed between two ligatures (for preferable method see text). The stumps of the cut vessels to the sigmoid are lettered to correspond.

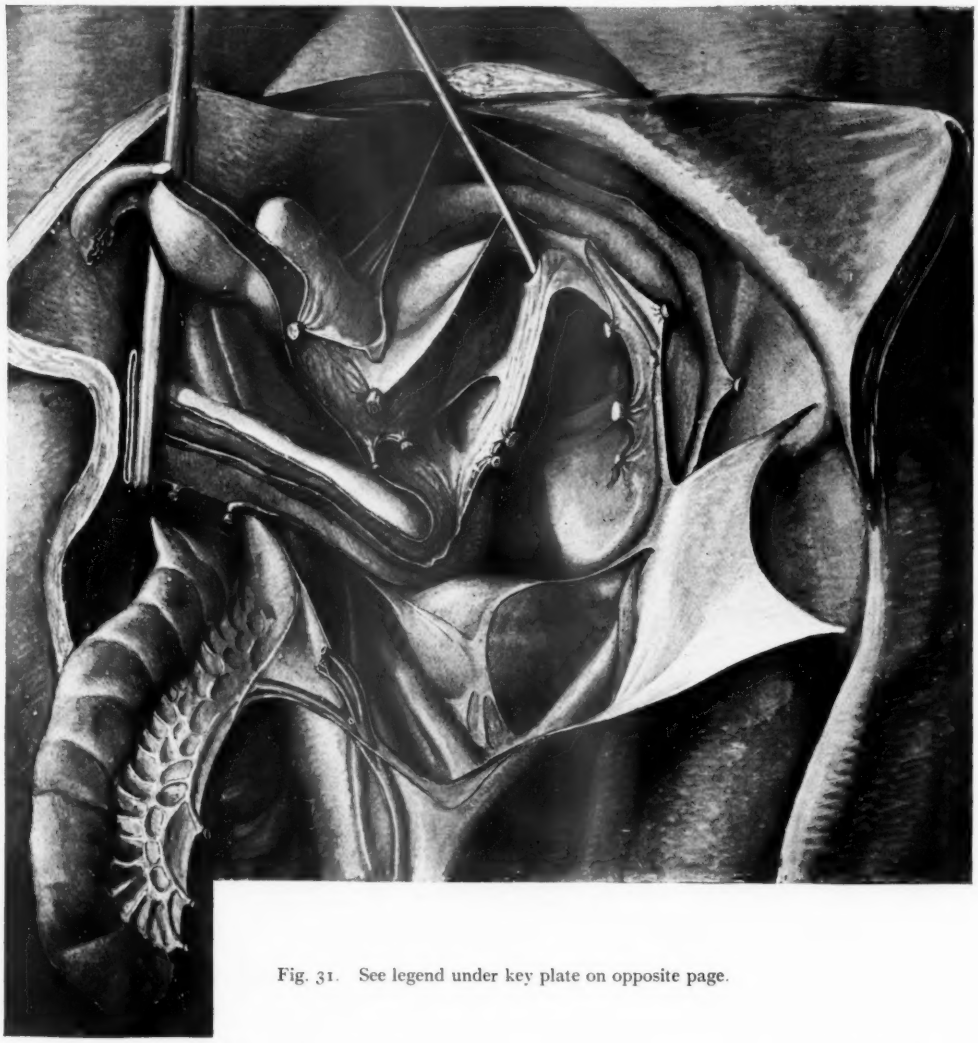


Fig. 31. See legend under key plate on opposite page.

this space in isolating for ligature and severance, the parametrial tissues lying below the ureter and bladder (Fig. 33 *hooks* 1 and 2 and *ligature*. Also Fig. 30). The *anterior border* of the parametrium situated in front of the ureter, passes into a thin fascia (*s t* Fig. 33) which suspends the ureter and bladder from the edge of the iliac fossa; and its deep *os-*

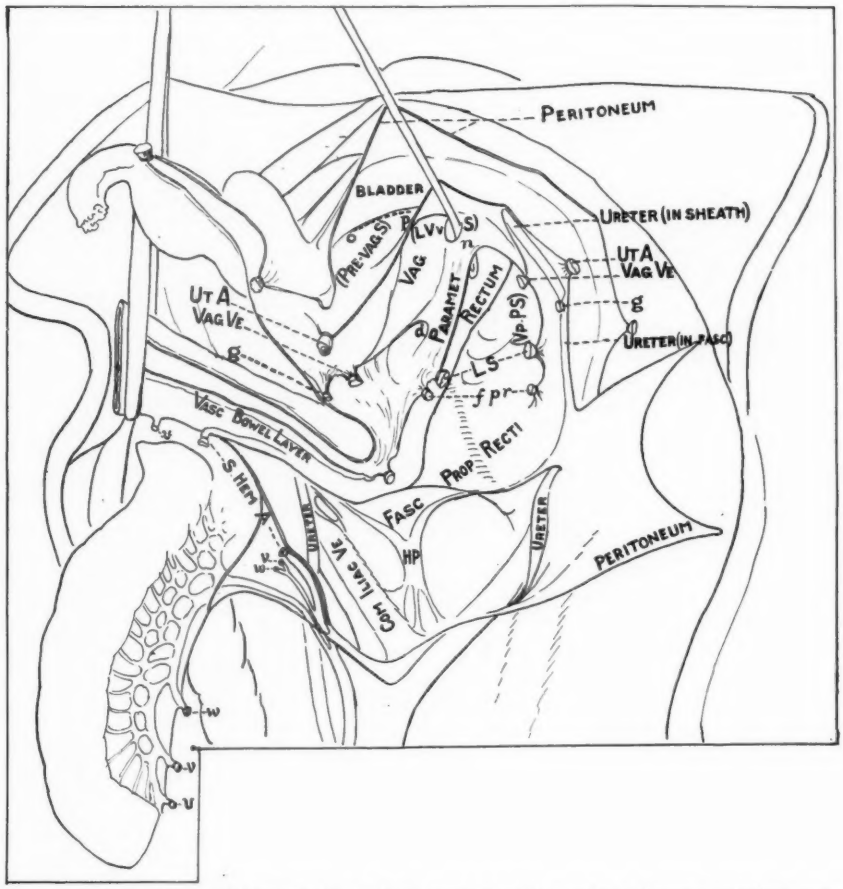



Fig. 31 shows the isolated mass of tissue (hook 2, Fig. 30) containing the arteries and nerves entering the rectum and vagina laterally, severed (stumps L S) out at the side wall of the pelvis, the attachments *w a* and *x' r*, Fig. 16, torn through, and separation of the rectum effected down to where the levator ani joins the anus. The vagina has still another bridge of parametrial tissue (*n*) attaching it to the base of the bladder below the level of the uretero-vaginal space, which comes into view as blunt separation is made downward through the lower angle of the incision *h i*, Fig. 29, along the side wall of the vagina. A lateral vesico-vaginal space (L V-v S) is thus opened up, the floor of which is formed of the parametrial tissue *n* raised on the hook, which contains a plexus of vessels. The vascular bowel layer (V B L) and the paratrium are seen to extend along the bowel and vagina in one continuous line. *o p*, line of transverse incision in the fascia of the prevaginal space for stripping the bladder away from the vagina below. *d*, opposite bottom of cul-de-sac. *f p r*, stumps of severed fascia propria recti.

*terior border* has a fascial attachment along the white line (Fig. 16 *w a*), which can be readily torn free by stripping from behind forward. The latter border, at its lower part, is the margin of that portion of the parametrium which is reflected over the surface of the bladder, so that it here forms a line of fixation of the base of the bladder to the pelvic wall. The ureter where it lies beneath the fascia supporting the uterine artery traverses a distinct compartment in the parametrium (Ureteral compartment of the parametrium, see text Fig. 21), by the opening up of which the the ureter is readily exposed for its avoidance in the subsequent steps of the operation. The inferior vesical vessels (Figs. 17 VES VAG VE

Fig. 32. See legend under key plate on opposite page.

and 32 and 33 INF VES Vs) run along the lower border of the ureteral sheath from which they can be readily dissected back, thus giving an opportunity to effect an entrance (Fig. 33 *q r*) at this situation into the vesicoparametriopelvic space. The parametrial connections between the side of the vagina and the base of the bladder, which have to be severed in a low dissection of the vagina, are, the fascial lining of the ureterovaginal space (Figs. 30 and 33 *h i*) and beneath it the vessel-carrying layer (Figs. 30 and 33 *e* and Fig. 31 *n*). The lower portion of the vessel-carrying layer (Fig. 31 *n*) is brought into view for division on opening the lateral vesicovaginal space (Fig. 31 L Vv S).

The five illustrations of this series show the approach to the region behind the rectum from above, and a method of isolating and dividing by this route the structures attaching the rectum and vagina laterally, internal to the ureters and the inferior vesical vessels.

Fig. 28 is the picture of a dissection of a male pelvis, here introduced to show particularly the opening *z* in front of the sympathetic nerve branches where they enter the paraproctium, approached through the pelvic retrointestinal plane of cleavage. The opening is produced by making the sympathetic nerve trunk taut by pulling on the fascia propria recti in which it normally lies, and then pushing with blunt force anterior to it, which raises the lateral peritoneal reflection onto the bowel off from the underlying tissues, thus establishing a line for the division of the peritoneum in this situation. In the female blunt penetration of the tissues is similarly made anterior to the sympathetic nerve trunk, which raises the peritoneum up from the underlying parametrium forward to the retroparametrial opening (Fig. 19 RP O).

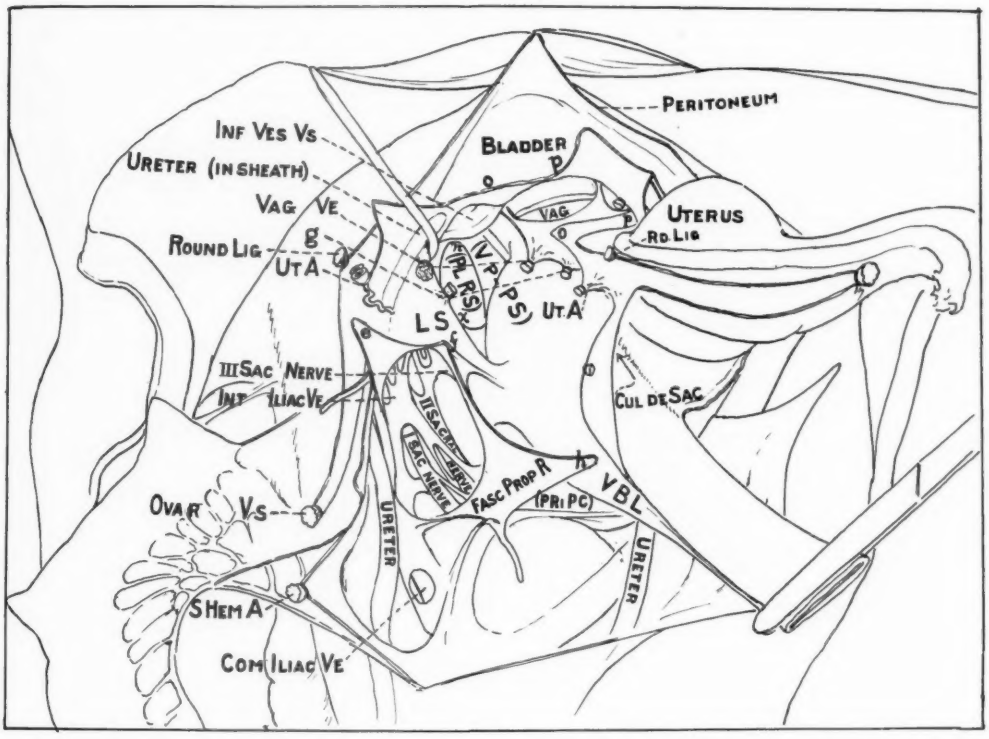



Fig. 32 shows the vesicoparametrio-pelvic space (VP-P S) opened up by the severance of the parametrium (stumps VAG VE and *g*) internal to the ureter and the inferior vesical vessels (INF VES VS), and the contents of the sacrosciatic space dissected out of their deep fascial connections after the fascia propria recti (FASC P R) had been raised off from them and split open (*e f h*). It also shows how a channel of cleavage (hook) (middle recess) can be opened up in that portion (L S) of the parametrial attachment to the pelvic wall which lies behind the ureter, just below the vaginal and middle hemorrhoidal (if present arteries, which latter can thus be more easily dissected out for ligature. The channel is reached from behind through the pelvic retrointestinal plane of cleavage by passing the finger first into the sacrosciatic space (Ss S, see text), and then forward in a line from the second sacral foramen to the spine of the ischium. Thus directed, the finger sinks into a fascial pouch fitting it closely, which is the sought-for track. This channel of cleavage follows the course of the internal pudic nerve. *o p*, *o p*, lines of severed fascia at bottom of prevaginal space. The vagina has been cut across in front below the prevaginal space, and then longitudinally down one side, thus outlining the portion to be removed. In the bottom of the vesicoparametrio-pelvic space can be seen the opening *x n* which leads into the postero-lateral rectal space (cf. Fig. 9, *x n*). P RI P C, pelvic retrointestinal plane of cleavage.

In the description of the operative technique, the opening *z* is called the *superior recess* entered through the pelvic retrointestinal plane of cleavage. There is no difference in the sexes in the general anatomical arrangement of this and the other two recesses (see step 1 of operation III, p. 215) opened up through the pelvic retrointestinal plane of cleavage. The hypogastric plexus (H P) of the sympathetic and the nerve trunk leading off from it on the right side have here been dissected out of the fascia propria recti in which they normally lie. In this and the subsequent dissections of the pelvic retrointestinal plane of cleavage, the vascular bowel layer (V B L) and the fascia propria recti could be split apart all the way down to the tip of the sacrum, while in Fig. 25 these layers could not be split apart below the middle of the sacrum.

Fig. 29 shows the approach through the peritoneal incision *j k* to the pelvic retrointestinal plane of cleavage (see text Fig. 25) and that

Fig. 33. The anatomical picture of the parametrium here is similar to that of Fig. 30, but the operative steps are different. The figure shows how, after exposing the ureter by the method shown in Figs. 18 to 21, the tissues can be tied off below the ureteral sheath (hooks 1 and 2 and ligature) and severed above it (grooved director), and the ureter in its sheath, together with the outer stump of the uterine artery which gives branches to the ureter, isolated in one well vascularized loop. This freeing of the ureter is done to expose the vesicoparametrio-pelvic space (Vp-P S) with its contents of fat and external iliac glands (Fig. 34). This figure also illustrates the best of any of the figures the anatomical relations of the retrointestinal plane of cleavage (see text, Fig. 25). The latter here extends down to the tip of the sacrum, which is the usual condition (cf. Fig. 25). Fasc P R, fascia propria recti which covers the sacrum, and laterally on eihter side the sacrosciatic space (Ss S, see text, Fig. 8), whence it spreads out to join at the brim the ureteral sheath, to form lower the fold *g g* supporting sympathetic nerve branches (cf. Fig. 30) and covering in the ureteral compartment of the parametrium (cf. Fig. 21), and near the bottom of the pelvis to cover the tissue (L S) containing the arteries and nerves entering the rectum and vagina laterally. (cf. L S, Figs. 9, 12, and 30.) In the portion of this fascia which has been raised from the right sacrosciatic space is seen the right sympathetic nerve trunk (Sy N). Rr S, retrorectal space (see text, Fig. 5) seen through an opening (*c d*) in the fascia propria recti, through which the postero-lateral rectal space (to Pl R S) (course of inferior recess) is directly entered (cf. Fig. 6). To Ss S indicates the best method of entering the sacrosciatic space through the abdominal approach, which is done by stripping up the lateral sacral attachment (*l m*, Fig. 8) of the fascia propria recti after entering the retrorectal space as here shown. Hook 1 enters the sacrosciatic space, passes through the channel of cleavage (Fig. 32, hook) (middle recess) below the laterally entering vessels to the rectum and vagina out to the spine of the ischium, where it then is forced through a fascial layer into the vesicoparametrio-pelvic space and emerges at the opening *q r*, including in this encirclement the inferior vesical vessels (Inf Ves Vs) (cf. Fig. 30, hook 2). *q r*, situation just inferior to a line at right angles to the ureter through the site where the uterine artery crosses the latter structure, at which situation cleavage can be effected between the ureteral sheath and the inferior vesical vessels (Inf Ves Vs), thereby entering the vesicoparametrio-pelvic space. *h i*, same site of entrance into vesicoparametrio-pelvic space as that similarly lettered in Fig. 30. *e*, vessel-carrying layer the same as in Fig. 30.

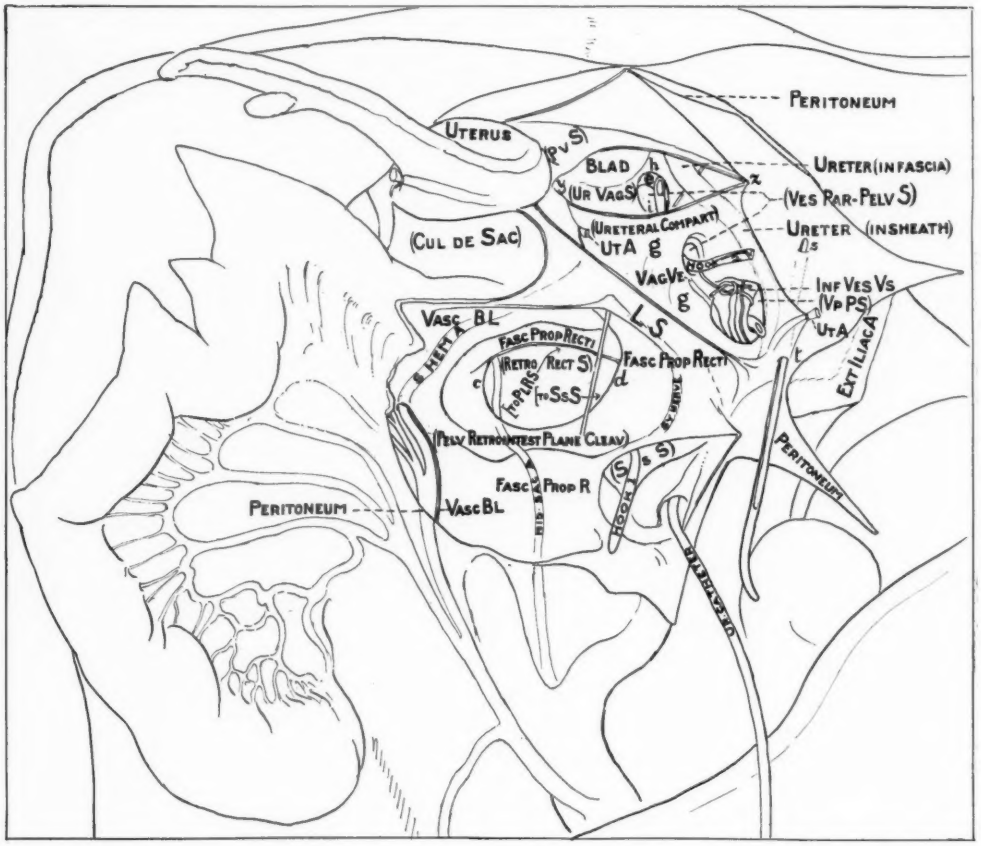



Fig. 33, *continued.*

UR-VAG S, uretero-vaginal space, here well defined. Near its cut edge (*y z*) the fascial lining of this space fuses with the layer *g g* of the parametrium. The *director* indicates the incision ST in the fascia suspending the ureter and bladder from the iliac fossa, made for the purpose of gaining access to the glands and fat of the vesicoparametrio-pelvic space (Fig. 34). SAC MED A, sacra media artery. LAT SAC A, lateral sacral artery. The course of the ureter is made prominent by the introduction of a catheter. The bladder (BLAD), near where the ureter enters it is made prominent by a sound inside.

to the deeper structures of the right parametrium below the level of the ureter. The right ovarian vessels have been tied and severed at the infundibulopelvic ligament, and the posterior peritoneal layer of the broad ligament has been cut transversely across below the ovary. The ureter has been exposed by the method already described (Figs. 18 to 22), except that the vaginal veins were raised off from the posterior fascial covering *g* (Fig. 21) of the ureteral compartment of the parametrium, instead of the underlying portion of this layer having been isolated with the veins. When the veins were tied and cut, the fascial floors of the ureterovaginal space and the ureteral compartment of the parametrium beneath seemed here to be continuous (cf. Fig. 33). *h i* is the location of the incision at the outer part of the fibrous floor of the ureterovaginal space where entrance is to be effected for completing the encirclement beneath the lateral attachment of the rectum and vagina.

Fig. 34. See legend under key plate on opposite page.

to the pelvic wall (Fig. 30 *hook* 2). Through this incision, which had best be extended the full length of the floor of the ureterovaginal space, the scalpel handle or finger introduced, encounters a second layer of fascia (Fig. 30 *e*) beneath, which is the lax resistant layer forming a part of the general fascial parametrial structure which carries the vessels to the rectum, vagina, and bladder. This layer can be picked up and teased through near its attachment to the base of the bladder, thereby effecting an opening (cf. Fig. 33 *h i*) which should lie between the vaginal artery and the inferior vesical vessels, leading directly into the vesicoparametriopelvic space. The finger now passed through this opening into the latter space and turned directly backward should find at a distance of about one inch the spine of the ischium, which can be recognized by its characteristic feel. Also this spine is found in a perpendicular line let fall directly backward from the point of intersection of the inner border of the psoas muscle with Poupart's ligament at a depth of about four inches. The spine of the ischium is now used as a guide for effecting an entrance from the vesicoparametriopelvic space into the posterolateral rectal space, the same as it was in effecting an entrance between these two compartments in the reverse direction from below (text of Fig. 8).

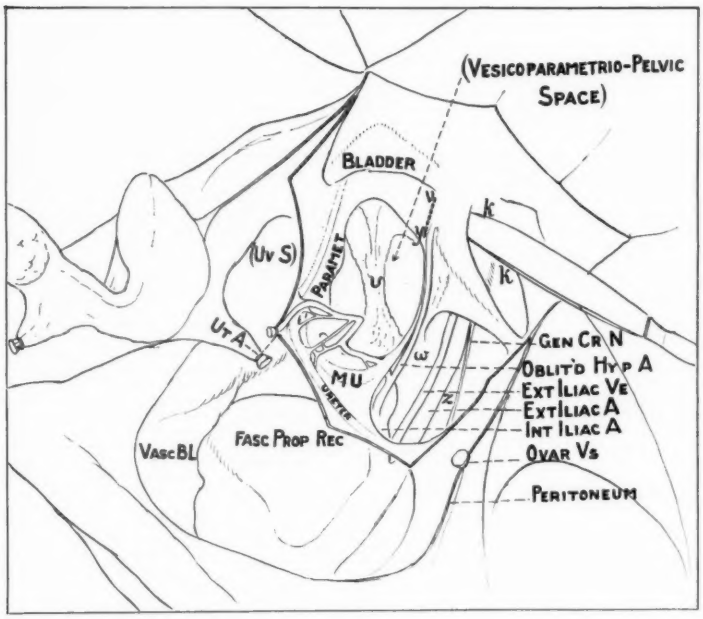



Fig. 34 shows how by cutting along the grooved director in Fig. 33 (*s t*) through the fascia suspending the ureter and bladder from the iliac fossa and extending the incision backward to the bifurcation of the common iliac artery, the vesicoparametrio-pelvic space is opened up demonstrating its contents of loose fatty tissue and glands, and also how the ureter in its sheath with the outer portion of the uterine artery (Ut A) giving branches to it, after division of the tissues in front and behind, can be isolated in one well vascularized loop. The ureter in its sheath and the adjoining portion of the bladder with their attached parametrium are readily separated inward from the contents of this space.

*k k*, situation of glands along Poupart's ligament in front of the vessels, firmly connected to the transversalis fascia.

*w*, lymphatic tissue dissected away from external iliac vein, continuous behind the vein with a deeper glandulo-fatty mass which is associated with the obturator nerve.

*z*, situation of external chain of external iliac glands, separated by a special fascia of the iliac fossa from the anterior and internal chains.

*u*, thick mass of fat found in this dissection in the bottom of the vesicoparametrio-pelvic space, just above the white line (cf. Fig. 17, F L.)

M U, membrane ureterica.

*v y*, incision through fascia along inner side of obliterated hypogastric artery (O H A) through which to split off the contents of this space from the bladder wall. The knife handle raises a fascial septum attaching the contents anteriorly.

Similarly firm pressure made with the finger over the spine of the ischium but in a backward direction, pushes through the fascia (Fig. 16 *w* and *x'*) into the posterolateral rectal space, thus joining with the inferior recess (see text Fig. 33, method of entering posterolateral rectal space from the pelvic retrointestinal plane of cleavage) and completing the circuit of the lateral attachment of the rectum and vagina to the pelvic wall. As the posterolateral rectal space is entered, the finger can be felt to glide into the angle formed by the meeting of the planes of the coccygeus and levator ani muscles. Also now, as previously done from below, with the finger in the fascial opening opposite the spine of the ischium, downward stripping will detach the adjacent-lying attachments (Fig. 16 *w a* and *x' r*) of the parametrium to the white line, and of the fascia propria recti to the fascia covering the levator ani, which together form the boundary line between the two spaces.

The extent to which the vascular bowel layer reaches laterally on the right side, which is a little more than an inch beyond its area of close contact with the posterior aspect of the bowel, is indicated by the letter *y* which marks

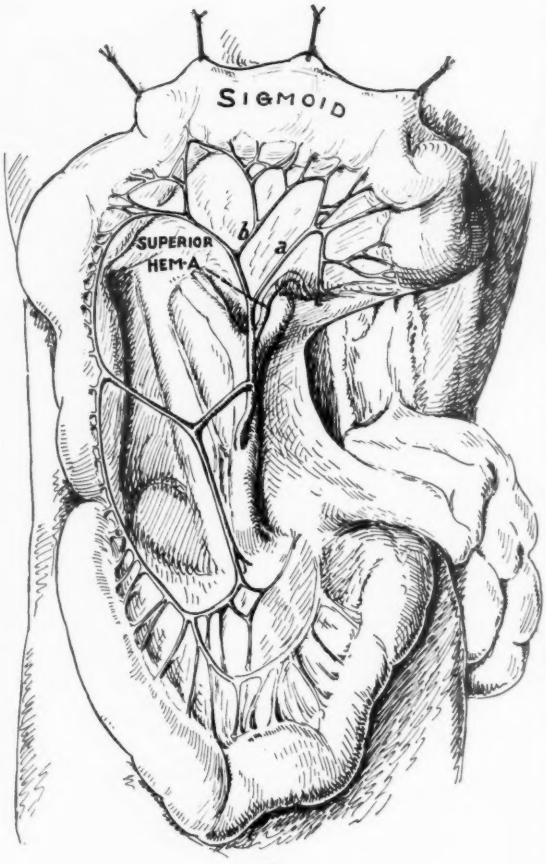



Fig. 35.

Fig. 35 shows the arterial supply of a loop of sigmoid thirty inches long, the main artery branching at intervals. It demonstrates an anatomical arrangement of the vessels, in the presence of which to free the bowel so that it can be straightened and at the same time to best conserve its nutrition, the branch *a* or the two branches *a*, *b*, which pass from the main trunk to the arterial arches, are shown to be the one or ones which should be severed, and not the main sigmoid trunk (see "Liberation of the sigmoid flexure," p. 173), dividing the lower one first and the second one afterwards if necessary.

the site where this layer terminates by fusing with the overlying peritoneum. The peritoneum along the side of the bowel out to its line of fusion with the vascular bowel layer, has a loose connection with the latter and can be stripped forward from it, thus opening up a *prismatic space* (*a*) extending down to the level of the bottom of the cul-de-sac. The opening of this space is done solely for anatomical demonstration and not as an operative step. On the right side a large hæmorrhoidal vessel is generally found in the vascular bowel layer rather close to the bowel, which is avoided by cutting along the line *y*. The vascular bowel layer on the left side projects but little beyond the margin of the bowel. The lower limit of the vascular bowel layer on either side of the bowel is at the parametrium.

Fig. 30 shows the parametrial tissues attaching the rectum and vagina laterally to the pelvic wall below the ureter, isolated (*hook* 2) through the abdominal approach as described under Fig. 29; also the bowel severed and the sigmoid mobilized in a manner similar to that already described under Fig. 27. The peritoneum has been cut downward along the side of the uterus and vagina to the bottom of the cul-de-sac and then upward along the bowel, it having first been raised from the parametrium in the line of the superior recess (Fig. 28 *z*) and the retroparametrial opening (Fg. 29 Rp O). To demonstrate the continuity of the vascular bowel layer with the parametrium (cf. Fig. 31), it and the peritoneum along the bowel have been here divided independently internal to the line *y* Fig. 29, though in the operation it is advised to cut the peritoneum just external to the line of fusion of these two layers in order to make a complete removal of the posterior cellular tissue. In this connection one must bear in mind that a too wide cutting of the peritoneum along the bowel leaves an insufficient amount of this tissue with which to bridge over the deep pelvic wound, in doing which latter the construction of a peritoneal diaphragm across the upper part of the true pelvis, is the best accomplishment one can hope to attain.

The best method of freeing the parametrial attachment to the pelvic wall, after first encircling it, would seem to be by dissection, tying the vessels when met, as recommended by

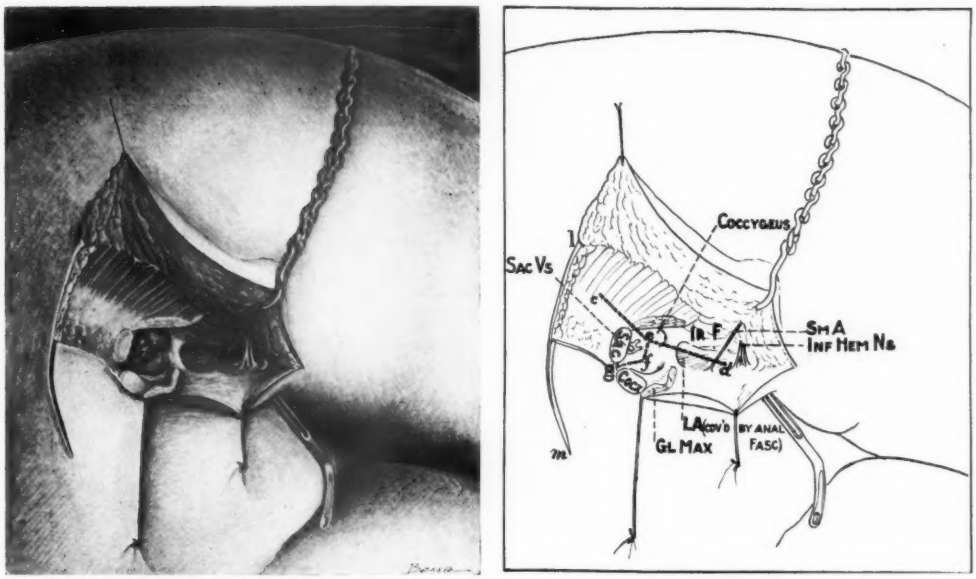



Fig. 36 shows the early steps in a method of approach to the rectum from behind, preliminary to making an exposure of the rectum corresponding to that shown in Fig. 37, or with some modifications, to that shown in Fig. 38. The dissection is one of a male with a narrow outlet. Skin incision in median line from fourth sacral vertebra to coccyx, then passes over right edge of coccyx into ischiorectal fossa ending just lateral to posterior margin of anal canal, beneath which point of termination at about one inch from the skin surface lie the terminal branches of the inferior hemorrhoidal nerves. The *director* in anal canal indicates the line of these nerves. The ischiorectal fat is then split off from the anal fascia and the inferior hemorrhoidal nerves located by dissection. An arched skin incision (*l m*) is made across the summit of the longitudinal one and the skin flaps thus outlined reflected from the surfaces of the glutei maximi muscles, to allow the lateral splitting and retraction of the deep structures. The attachment of the right gluteus maximus (Gl Max) to the coccyx (Cocx) has been severed, and the coccyx disarticulated, dissected from its anterior connections and turned to the left. *c e d*, line of deep muscular incision to open into the right postero-lateral rectal space. *e f g*, line of incision across dense tissue forming floor of space from which coccyx was removed. Cocg, coccygeus. L A, levator ani. Sac Vs, terminations of sacral vessels. Sm A, small arterial branch. Ir F, ischiorectal fat raised off from anal fascia.

Mackenrodt, though in this specimen the tissues were tied off in two masses, one consisting of the reflection of fascia propria recti raised by the *hook I* (Fig. 31 stumps *j p r*), supporting sympathetic nerve branches to the vagina, which really need not have been tied at all, and the other comprising the balance of the encircled tissue over *hook 2* (Fig. 31 stumps L S), consisting of the tissue containing the laterally entering arteries and nerves to the rectum and vagina. The writer has found it better to split this latter mass in two as described under Fig. 32 (*hook*) which enables the upper portion containing the vessels, to be tied separately, after which the remainder of the tissue below, consisting of nerves and fascia, can be cut probably without ligature. *c* is a firm fascial attachment of the rectal sheath to the lateral mass of the second sacral vertebra, peculiar to this dissection, which had to be cut.

Fig. 31 shows the parametrium severed laterally, in the course of *hook 2*, Fig. 30, and the rectum and vagina thus freed, completely stripped from the side wall and floor of the pelvis down to the line of attachment of the levator ani to the anus. The finger pushed downward alongside of the vagina through the incision *h i* Fig. 29 in the fascia lining the ureterovaginal space, opens up a deeper plane of cleavage (lateral vesicovaginal space, L Vv S) between the base of the bladder and the side of the vagina. Forming the posterior

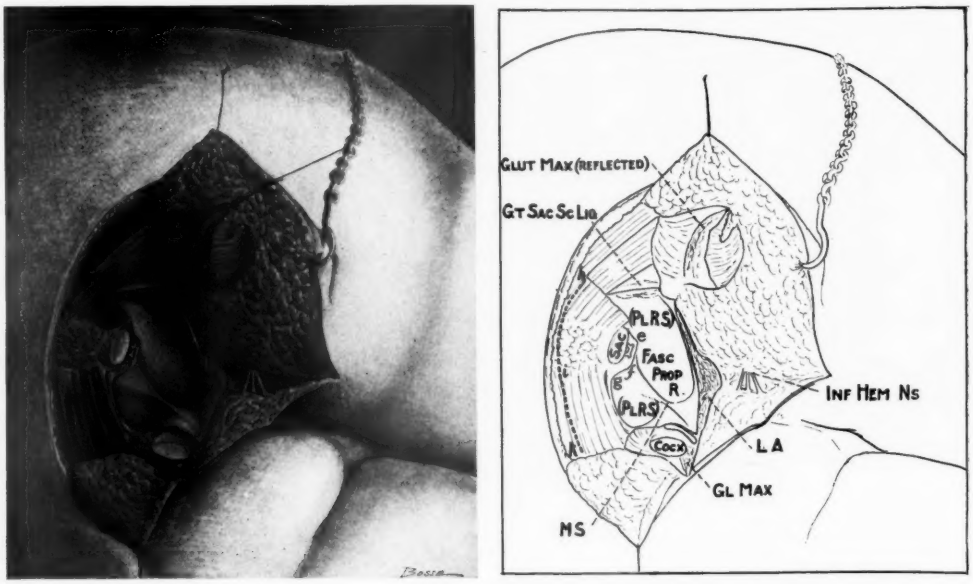



Fig. 37 shows the exposure of the rectum from behind, (cf. text, Fig. 4) with no bony removal other than the coccyx. The deep longitudinal incision of approach (*c e d*, Fig. 36) is enlarged by lateral incisions splitting the muscles in the course of their fibres, that on the right side lying just below the inferior lateral angle of the sacrum and extending out toward the spine of the ischium, and that on the left side being at the level of the sacro-coccygeal joint. In the right lateral incision the gluteus maximus fibres are dissected off from the greater sacrosciatic ligament (GT SAC SC LIG). PL R S, postero-lateral rectal spaces. M S, median septum between these spaces. *h i*, line of transverse section (with osteotome) of sacrum just below inferior lateral sacral angles and *i k*, line of splitting the left gluteus maximus muscle outward toward the spine of the ischium, in the approach shown in Fig. 38. FASC PROP R, fascia propria recti (see text, Fig. 4).

boundary of this plane of cleavage is a still lower fascial fold of parametrium (*n* raised on hook) connecting these organs, in which lies a plexus of veins. The reflection of the fascia propria recti covering the structures of the great sacrosciatic notch has been left in situ. The vascular bowel layer is seen to be continuous below with the parametrium.

Fig. 32 shows the portion (L S) of the left parametrium which is fixed to the pelvic wall behind the ureter, intact, and below it the mobile portion of the parametrium which is suspended from the iliac fossa, divided (stumps *vag ve* and *g*) internal to the ureter and inferior vesical vessels (INF VES VS), whereby the vesicoparametriopelvic space (VP P S) has been laid widely open. Behind the tissue L S, the figure also shows the reflection of the fascia propria recti (FASC P R) over the sacrosciatic space (Ss S see text Fig. 8) split open (*e f h*) and the contents of this space, which are normally held together by a smooth layer of deep fascia, dissected out. The object of particular interest is the lateral attachment (L S) of the rectum and vagina to the pelvic wall, which it is here shown can be split along a natural channel of cleavage (course of the *hook*) into two parts, an upper one in which lie the middle hæmorrhoidal vessels, when present, and the vaginal artery if normally situated; and a lower one consisting of the branches from the third and fourth sacral roots (Fig. 12) to the pelvic plexus of the sympathetic, covered by a dense fascia which is firmly connected along the third and fourth sacral foramina. By thus isolating the laterally entering arteries they can be ligatured independently of the dense lower portion of this lateral attachment, the inclusion of which latter in the ligature would make it necessary to leave behind much more

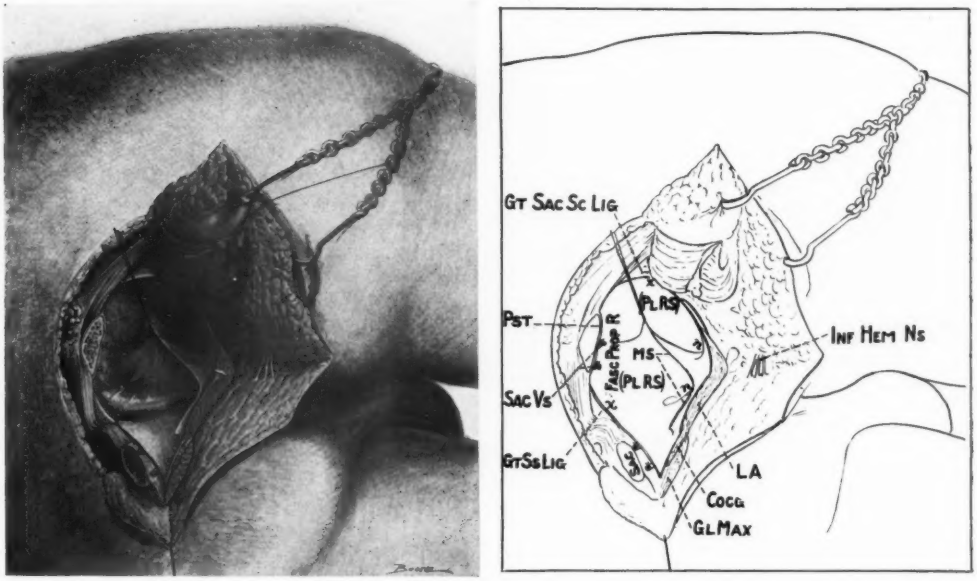



Fig. 38 shows the exposure of the rectum from behind with section (Fig. 37, *h i*) of the sacrum (SAC) just below the level of its inferior lateral angles (cf. Fig. 6, FRGT 1), and lateral splitting of the glutei maximi muscles of the two sides at the same level outward toward the spines of ischia, avoiding the greater sacrosciatic ligaments (GT SS LIG). The preliminary steps are the same as those shown in Fig. 36, except the coccyx need not be disarticulated. This approach opens widely both postero-lateral rectal spaces (PL R S), affording ready access to the lower pelvic attachments (Fig. 8, *l m x n*) of the fascia propria recti and the lower extremities of the parametrial attachments to the pelvic wall (Fig. 9, L S) containing the laterally entering structures. SAC VS, sacral vessels readily found in loose connective tissue after first cutting through the dense periosteum (PST) in front of the line of bone section. M S, median septum severed. *x n*, *x n*, the same as *x n*, Fig. 8.

of the parametrial tissue in the stump at the pelvic wall than if the ligature tied the vessels only. The lower portion can afterward be hooked up over the finger and cut, probably without any ligature of it being necessary.

The above channel of cleavage below the laterally entering vessels to the rectum and vagina, here designated the *middle recess* opened up through the pelvic retrointestinal plane of cleavage, lies in a line from the second anterior sacral foramen downward to the spine of the ischium and can be entered from behind after having raised the reflection of the fascia propria recti off from the smooth fascia covering the structures of the great sacrosciatic notch, that is, after having opened up the sacrosciatic space. The sacrosciatic space can be opened by way of the retrointestinal plane of cleavage either in the course of the *hook I* Fig. 33 or else by first entering the retrorectal space as shown in Fig. 33, and then from within this area, tearing through the lateral attachment (*l m* Fig. 8) of the fascia propria recti to the sacrum (see Fig. 33 [to Ss S]). The latter seems to be the more direct and, therefore, the better operative method. The finger entering the sacrosciatic space and taking the direction of the given line, opens up the channel of cleavage out to the spine of the ischium, the walls of which fit snugly around it like a glove. The hook in this illustration passed in the reverse direction, demonstrates the track that would be thus taken by the finger. It is recommended to always open this channel of cleavage at the beginning of every operation for excision of the rectum by the abdominal route, which locates the vessels at once for the prompt control of any hæmorrhage from their branches as well as for facilitating their dissection before ligature.

The writer has in a number of dissections

found a gland on the internal iliac vein about opposite the second sacral foramen. The fascia lining the prevaginal space has been cut across (*o p*) at its lowest limit, which enables the bladder to be stripped downward from the vagina about three-quarters of an inch further. The vagina has been cut across the front as low down as possible and then longitudinally down one side, thus outlining the portion to be removed. When the lateral incisions have been carried down both sides of the vagina the posterior wall can then be cut across low down, thus isolating the bowel completely for its severance above the internal sphincter.

IV. *Wide radical excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor, with *removal of the regional glands*, entirely by the *abdominal route* (Figs. 33 and 34).

The figures of this group show the highest development anatomically of the operation for removal of rectal cancer, comparable with the highest development of the operation of wide radical excision for cancer of the cervix uteri. The operation contemplates the freeing of the parametrium on either side below the level of the ureteral sheath and bladder; the freeing of the ureter above its sheath (Fig. 33 *director*) leaving in situ the outer extremity of the severed uterine artery giving branches to it (Fig. 34); the removal of the fat and glands from the vesicoparametriopelvic spaces laid open by this isolation of the ureters and the dissection and severance of the parametrial tissues where they are attached to the pelvic wall along the line of entrance of the vessels and nerves. It is apparent that such a complete operation as this can be done only by the abdominal route by which alone the iliac glands can be reached.

Fig. 33 illustrates, the best of any of the figures, the anatomical relations of the pelvic retrointestinal plane of cleavage (see text Fig. 25), and those of the parametrium after the exposure of the ureter (Figs. 18 to 21). It indicates how the tissues can be tied off below the ureteral sheath and severed above it (*s t*), thereby isolating the ureter in its sheath together with the outer stump of the uterine artery which gives branches to it, in one well-vascularized loop for the purpose of gaining access to the vesicoparametrio-pelvic space (Fig. 34).

In opening up the retrointestinal plane of cleavage in this dissection (cf. Fig. 25), the fascia propria recti is seen to have been split off from the vascular bowel layer (V B L) all the way down to the tip of the sacrum so that its complete lateral reflections come into view, first extending over the sacrosciatic space (Ss S and Fig. 32 *e f h*), and thence prolonged above out to the ureter at, and a little below the brim, also lower to form the fascial posterior covering *g* of the ureteral compartment (Ur C) of the parametrium, supporting the sympathetic nerves to the vagina, and finally prolonged below to cover over the mass of tissue L S containing the laterally entering arteries and nerves to the rectum and vagina. The sympathetic nerve trunk has been dissected out of this fascia for a short distance on the right side.

*The methods of entering the posterolateral rectal* (see text Fig. 4 and Fig. 6 Pl R S) *and the sacrosciatic spaces* (see text Fig. 8) *from the pelvic retrointestinal plane of cleavage* are also here indicated, both of which are important operative steps. Entrance to the former spaces through this route establishes a channel on either side, here designated as the *inferior recess*. These channels are opened up for the purpose of stripping around the lower limits of the lateral parametrial attachments (L S) of the rectum and vagina to the pelvic wall, to aid in their subsequent detachment. The method employed is to first grab with a long-handled forceps a fold of the fascia propria recti over the front of the lower portion of the sacrum, with which instrument pull the fascia taut away from the sacrum, then incise the portion of the fascia thus made tense and pass the finger directly through the opening until the bodies of the sacral vertebræ can be directly felt, which indicates that the retrorectal space (Rr S and Fig. 6 Rr S) has been entered. The sacra media (S M a) and lateral sacral (L S a) arteries disclosed within this space, are bound down to the sacrum apart from the fascia propria recti and need not be injured. The fascial attachment along the third and fourth sacral foramina, which forms the posterior extremity of the line of parametrial attachment

to the pelvic wall, lying, near its bony connection, flat against the pelvic wall, does not here come into view. The finger now passed into the retrorectal space and pushed laterally in it off to either side below the level of the fourth sacral foramen ([to PL R S]), enters the posterolateral rectal spaces by tearing through the delicate V-shaped lower portion of the attachment of the rectal sheath (fascia propria recti) to the sacrum below the fibrous cords *m m'* Fig. 8. The isolation of the base of the lateral attachment is then completed by pushing the finger outward through the space, along the lesser sacrosciatic ligament to the spine of the ischium, at which point the limit of the inferior recess is reached.

The sacrosciatic spaces are entered not only in the quest for possible glands, but also for the purpose of opening up the channel of cleavage (*middle recess*) immediately below the vessels entering the rectum and vagina laterally from the pelvic wall, in the line from the second anterior sacral foramen to the spine of the ischium (see *hook* Fig. 32), to facilitate the dissection of these vessel trunks for their independent ligature. The sacrosciatic space can be entered either in the course of the shaft of the instrument (*hook I*) protruding from it at the brim, by stripping the fascia propria recti downward from the site of the opening off from the fascia binding down the contents of the space, or, more conveniently, by first entering the retrorectal space through the opening (*c d*) in the fascia propria recti and then from within this space stripping up the lateral attachment of the latter fascia to the sacrum (Figs. 8 and 9 *l m*), at the site indicated by the arrow ([to Ss S]). The latter method of approach has the advantage of raising at the same time the sympathetic nerve trunk supported in the texture of the fascia propria recti, which can be readily detected by its cord-like feel when tension is made on the fascia and then straightway utilized as the guide in raising the peritoneal fold lateral to the rectum and cul-de-sac (*superior recess* Fig. 28 Z) in the line for its severance.

Thus it is seen that through this retrointestinal plane of cleavage the bases of the lateral attachments of the rectum and vagina to the side wall of the pelvis are isolated (inferior recesses), the laterally entering vessels to the rectum and vagina are located (middle recesses) in a way to aid their dissection, and the peritoneum is raised from the parametrium alongside of the rectum and cul-de-sac (superior recesses) in a line for its severance. Furthermore, if there be any question regarding the operability of a case, a posterior dissection of this sort permitting deep palpation laterally might give valuable information. For these reasons as well as because of the facts that it exposes the internal iliac arteries for their ligature if desired, and enables the ureters to be located at the brim, and the uterus to be raised about one inch and a half higher in the pelvis thereby making the parametrium more accessible for manipulation, *this dissection through the pelvic retrointestinal plane of cleavage is recommended as an advisable first procedure in every operation by the abdominal route contemplating the removal of the rectum, uterus, and part of the vagina.*

*Opening into the vesicoparametrio-pelvic space and detachment of the parametrium.* When the posterior intrapelvic dissection was finished, the peritoneum was severed and the ureters were exposed (Figs. 18 to 21) as shown in Fig. 30, but different from Fig. 30 the dissection of the parametrium here indicated, is one to afford a more thorough removal of the tissues. Instead of cutting first through the floor of the ureterovaginal space, as was done in Fig. 29 (*h i*), a site was here chosen close behind the ureteral sheath just below a line drawn across the ureter at the situation of the uterine artery, where an incision (*q r*) was made in the thin fascia, parallel to the ureter. Through this fascial opening blunt separation pushes backward the inferior vesical vessels (INF VES VS) from the ureteral sheath, and entrance is thereby gained to the vesicoparametrio-pelvic space into which the finger can now be made to penetrate. In a fat body the entering finger meets therein the soft fatty pad (Fig. 34), and in a thin body the thin layer of loose fat, which cushions the interior of the space, either of which fatty layers it can press through until it meets the smooth pelvic fascia. Then finding in the vicinity the bony anterior margin of the great sacrosciatic notch or the posterior edge of the obturator internus muscle overlying it, the

finger follows this obliquely downward and backward for about an inch, to a point where it reaches the spine of the ischium. In locating the spine of the ischium this bony prominence will be found to lie in the course of a perpendicular let fall from the situation of Gimbernat's ligament into the pelvic cavity with the body horizontal, at a distance just reached by the tip of the index finger of a medium sized hand with its metacarpophalangeal joint opposite the great vessels at the brim, or about four inches behind the great vessels. Backward and downward pressure against the spine of the ischium now tears through the fascial attachments (Fig. 16 *w* and *x'*) at this situation, into the posterolateral rectal space, thus joining with the channel of cleavage (inferior recess) into this same space already made below the lateral parametrial attachment of the rectum and vagina to the pelvic wall through the retrointestinal plane of cleavage (see opening [to PL R S]). The channel of cleavage (middle recess Fig. 32 *hook*) below the vessels to the rectum and vagina entered from behind through the sacrosciatic space is also now, or later, forced through at its fascial apex ending at the spine of the ischium to connect with the opening *q r*, whereby the upper vascular portion of the parametrial attachment to the pelvic wall is completely isolated from the nervous and fascial portion of the attachment below. In this illustration the *hook I* which passes through the middle recess below the vessels, having its exit at the opening *q r*, encircles in addition to the arteries to the rectum and vagina, the inferior vesical vessels (INF VES VS). The writer believes that the upper vascular portion of this lateral connection to the pelvic wall should first be dissected apart and the cellular tissues stripped from the vessels before the latter are ligatured in order to get a more thorough wide removal of all the lymphatic tissue, in acordance with the recommendation of Mackenrodt in cancer of the cervix uteri. These vessels lie in loose connective tissue at their roots and after stripping off the reflection of fascia which covers them superiorly, can be easily separated. The lower fibronervous portion of this pelvic wall attachment the writer believes can be severed without ligature. Severance of the nerves should not be made too close to the pelvic wall or the sacral roots might be injured, though this does not seem likely of occurrence. The severance of this fixed pelvic attachment of the parametrium is done with most ease after the mobile portion has first been detached from below the ureteral sheath and base of the bladder (*hook 2* and *ligature*) and the vesicoparametriopelvic space thus opened freely into, which exposes to view and reach the lower surface of the pelvic wall attachment.

Illustrative of the anomalies in vascular supply, in this particular dissection arterial branches corresponding to the middle hæmorrhoidal distribution as well as the vaginal artery were all given off by the superior hæmorrhoidal artery, thus leaving no vessel of entrance to the rectum and vagina from the side wall of the pelvis.

The incision *h i* made here in the floor of the ureterovaginal space and continued through the vessel-carrying layer (*e*) of fascia beneath, below the base of the bladder to enter the vesicoparametrio-pelvic space, is made in an identical manner to the incision *h i* Figs. 29 and 30 (see text Fig. 29). Between this opening and the one *q r* the intervening parametrial tissues attached along the base of the bladder and ureter, including the inferior vesical vessels (INF VES VS), can be tied off in one or two masses (*hook 2* and *ligature*). There then remains of parametrial tissue still to be freed, that connecting the vagina to the base of the bladder below the ureterovaginal space, corresponding to *n* Fig. 31, which is reached by stripping bluntly through the incision *h i* downward along the vaginal wall and opening up the lateral vesicovaginal space (Fig. 31 L Vv S).

There now remains a very interesting feature of this dissection, namely the *method of approach to the external iliac glands and the fatty cushion which together fill the vesicoparametrio-pelvic space* (Fig. 34). This is done by incising the fascia suspending the ureter and bladder from the edge of the iliac fossa in the line of the director *s t* inserted beneath it. This fascia can be directly isolated for incision by passing the finger into the opening *q r* and sliding it upward external to the ureteral sheath, when it will appear beneath the thin fascia above, which it has raised from the underlying

cushion of fat. Ries, Mackenrodt, and Bumm, each describes the approach at the pelvic wall to reach the ureter and external iliac glands (see manipulation of the ureters p. 137).

Fig. 34 shows how by cutting along the grooved director (*s t*) in Fig. 33 through the fascia suspending the bladder and ureter from the iliac fossa, the incision passing backward above the uterine artery as far as to the bifurcation of the common iliac artery, the vesicoparametrio-pelvic space is opened up, demonstrating its contents of loose fatty tissue and glands, and also how the ureter in its sheath with the outer portion of the uterine artery giving branches to it, after division of the tissues in front and behind, can be isolated in one well-vascularized loop. In making this incision the writer suggests saving the outer stump of the uterine artery with its vascular supply to the ureter. It would hardly seem possible that the lymphatics associated with this arterial supply to the ureter would become involved in those cases of cancer of the rectum where the ureteral sheath has remained healthy, wherefore one might reason that whenever the ureter can be saved this vessel could be permitted to remain. By making the cut *s t* between the ureter and the obliterated hypogastric artery (O H A) which latter lies anterior to the ureter, the best access to the space is secured. This obliterated vessel can be detected before making this cut, by the finger introduced through the opening *q r* Fig. 33 and pushed forward under the fascia. In a fat subject the obliterated hypogastric artery may attain such proportions as to lead one into mistaking it for the ureter.

*The vesicoparametrio-pelvic space* (cf. Figs. 9, 15, 16, 17, and 32 Vp P S) is thus named from its location between the parietal surfaces of the bladder and parametrium (see p. 192) internally, and the opposing structures of the pelvic wall and the external iliac vessels externally. The area where the spaces of the two sides intervene between the bladder and the pubic bones corresponds to the prevesical space. Each space is quadrilateral in outline like the pocket of a coat, its *upper limit* being along the site of entrance into the parametrium of the vessels from the side wall of the pelvis a little above the lower margin of the great sacrosciatic notch, the deep *limit posteriorly* being at the site of fascial attachment of the posterior border of the parametrium and base of the bladder to the white line (Fig. 16 *w a*), the *inferior limit* at the symphysis pubis, and the *anterior limit* along the external iliac vessels. The *contents* of this space are fat and glands, which structures along the external iliac vessels and obturator nerves are intimately associated in one mass; but a little behind the obturator nerve, extending down into the bottom of the space, there is always found a mass of plain fat (U) which having very delicate areolar connections is consequently very easily torn loose. These contents form a layer which cushions externally the mobile parietal surfaces of the parametrium and bladder together making up the inner wall of the space. The outer and inner surfaces of the glandulo-fatty layer are loosely connected to the walls of the space so that they can be readily stripped free. Thus it is seen here that as the incision *s t* (Fig. 33) is opened up the ureter in its sheath and the adjoining portion of the bladder with the parametrium attached to both, are readily separated from the inner surface of the fatty pad. Also with comparative ease the contents themselves are stripped inward from along the external iliac vessels at their mid area and from the fascia of the pelvic wall behind this situation. At its upper limit this layer has a connective tissue attachment of moderate firmness along the internal iliac artery, which can be torn free, and below, very firm fascial septa (*k*) attach it along Poupart's ligament opposite the external iliac vessels, also to the region behind the femoral canal, to the horizontal ramus of the pubis, and to the lateral aspect of the top of the bladder. Lying under cover of the fascial attachment across the ramus is found the obturator artery when this vessel takes its origin from the external iliac. The deep epigastric artery is also in relation with a fascial offshoot from the glandulo-fatty mass. Along Poupart's ligament lying in front of the vessels and firmly connected to the transversalis fascia, is a prominent row of glands which runs off internally into the fatty contents of the space along their attachment to the horizontal ramus. The fascial connections of these latter glands are so firm that they must be cut loose.

In cleaning out this space, those glands in

front of the external iliac vessels which are situated above the group along Poupart's ligament, can first be dissected off from without inward and then those at the inner side of the external iliac vein, after which the glands around the obturator nerve lying a little behind the external iliac vein can be stripped out, and the deeper fatty portion (U) of the contents raised from the pelvic fascia. Finally, the upper attachment of the glandulo-fatty layer along the internal iliac artery, having been teased loose, the lower fascial connections are dissected free. In freeing the glandulo-fatty mass from its firm fascial connections below, cleavage between this tissue and the bladder is effected by incising (*v y*) the fascia just internal to the obliterated hypogastric artery near its reflection onto the abdominal wall, and then through the opening thus made pushing backward with the finger across the horizontal ramus. This, besides cleaving the tissues, also hooks up the fascial connection to the bladder near its top, which can be cut. Injury to the bladder can be avoided by locating the thickened fold corresponding to the margin of this viscus by the sense of touch, or by the introduction of a sound within the organ. The external chain of the external iliac glands lies in the sulcus (*z*) between the external iliac artery and the psoas muscle. It is covered over by a layer of deep fascia separating this from the other chains of these glands, and, in cancer of the cervix anyway, is less liable to involvement than are the glands lying anteriorly and interiorly to the vessels. The genitocrural nerve (Gc N) pierces the glandular mass attached just beneath Poupart's ligament, in front of the external iliac artery. The outer stump of the uterine artery (Ut A) is shown dissected from its bed on the membrana ureterica (M U), distributing its branches to the ureter. The superior vesical artery, which here was absent, when present follows the obliterated hypogastric artery, on its way to the bladder, giving off a branch to the ureter.

OPERATIVE STEPS ENUMERATED IN SEQUENCE

1. *Close local excision of the rectum alone* above the pelvic floor, by the *posterior route*, or by the *combined* posterior and abdominal *routes* (Figs. 1 to 14 and Fig. 25).

The illustrations show: Horseshoe incision with deep median levator-coccygeal approach; entrance into the rectal sheath with shelling out of the rectum therefrom; division of the vascular and nervous connections close to the rectum; entrance to cul-de-sac and severance of the lateral fibro-peritoneal attachments. Also approach from above through the pelvic retrointestinal plane of cleavage (Fig. 25).

Fig. 1. Horseshoe flap outlined, its base lying between the tuber ischii, and its summit arching across the tip of the sacrum, which flap was here made for a better exposition of the underlying anatomy, yet for operative work the Kraske or the Hochenegg approach or the proposed approach shown in Figs. 36, 37, and 38 would be preferable (retrorectal incisions, p. 219). As the horseshoe flap is raised, at the lower borders of the glutei maximi muscles the ischiorectal fat is incised to reach the smooth anal fascia covering the levatores ani and reflected from either side over the posterior fibers of the external sphincter. Following the latter fascia of the two sides to the median line, the posterior fibers of the external sphincter, which can be felt bound down by the fascia, are raised (*hook*) from the levatores ani, and their attachment to the coccyx cut.

Fig. 2. The horseshoe flap containing the posterior fibers of the external sphincter is reflected downward, exposing mesially the united levatores ani fibers beneath, which in this locality are disposed in two layers.

Fig. 3. The superficial layer of the united posterior portions of the levatores ani is cut directly down upon in the median line until the aponeurotic structure (*h*) of the deeper layer is met. The handle of a scalpel now passed downward in the median line along this aponeurotic structure, below separates backward the puborectalis from the posterior aponeurotic fibers of insertion (*i*) of the levatores ani into the anus. Coccyx excised.

Fig. 4. Open one posterolateral rectal space (Pl R S) (see text Fig. 4) by the incision *j k*, a little to one side of the median line, taking care, at the lower angle of this incision where the levator ani joins the bowel, not to cut into the latter. Then open the other postero-lateral compartment by first making a transverse incision through the floor of the space from

which the coccyx was removed, a little below the tip of the sacrum — so that the sacral vessels can be caught — connecting with the primary incision, and then through the opening thus made into the compartment of the opposite side, hooking up the median septum (M S) between the spaces and dividing it.

Fig. 5. Push with the finger at the tip of the sacrum in the course taken by the knife handle, which separates the fascia propria recti (see text Fig. 4) from the bodies of the sacral vertebræ (Fig. 6).

Fig. 7. Make incision *o p* in fascia propria recti and (Fig. 8) through it introduce the finger in the courses taken by the knife handle and the hook. Encircle with the finger the fibrous cord *m* and cut it. The attachment *l m* to the sacrum above this point readily tears through as high as to the first sacral vertebra, the finger then entering the sacro-sciatic space (Figs. 9 and 33 Ss S and text Fig. 8), in which it strips its way downward as far as to the lateral attachment (L S) of the rectum and vagina to the pelvic wall. Incise the rectal sheath (fascia propria recti) on either side in a line corresponding to *q r* Fig. 8. Shell the longitudinal coat of the rectum back from its sheath and enter the prerectal space, if necessary by an incision (*s t* Fig. 10). Incise laterally (Fig. 11 *u v*) the fascia forming the top of the prerectal space and through the opening make an upward blunt dissection alongside of the cul-de-sac, which separates out the tissue containing the laterally entering vascular and nervous structures of the rectum (Fig. 11 L R and Figs. 12 and 14), close to the bowel. Divide L R between two ligatures, which must be done before the bowel can be drawn down. Enter the cul-de-sac, and divide the lateral fibroperitoneal attachment of the bowel in the line of the director (Figs. 13 and 25), which may allow additional descent of the bowel, particularly of the front portion, but sometimes it does not on account of a shortness of the fascia propria recti. In the presence of the latter condition an additional descent of about two inches of the bowel can yet be gained by dividing the fascia propria recti transversely across over the back of the bowel, and then raising the bowel with its accompanying vessels and lymphatics off from the front of this layer, in the accomplishment of which it is necessary to sever as well a median attachment between fascia and rectum existing below the level of the third sacral vertebra. Also, any remaining lateral attachment restraining descent of the bowel must be divided. In rectal cancer situated sufficiently low, local excision and suture of the bowel ends not necessitating the division of the superior hæmorrhoidal vessels may be done entirely through the posterior approach (see Kraske's resectio recti from below, p. 130). In performing the operation of resectio recti by the posterior route three times on the cadaver, the writer has each time been able, without the ligature of the superior hæmorrhoidal vessels, to remove about three and one-half to four inches of the gut and at the same time leave sufficient length of upper segment to enable the bowel ends to be sutured together, in two of these instances it being necessary to divide the fascia propria recti transversely and shell the bowel off from it, and once not.

In high-seated cancer to determine and treat the upper conditions the abdominal approach should be utilized. This approach, when employed in conjunction with the posterior one, should be made the seat of primary procedure, while the finish of the operation is done through the posterior route (Kraske). In close local excision of the bowel the preliminary steps to be performed through the abdominal route would then be: The opening up of the pelvic retrointestinal plane of cleavage (Fig. 25); the ligature and division of the superior hæmorrhoidal vessels; the division of the lateral peritoneal attachments of the bowel; the opening up of the retrorectal (Figs. 25 and 33) and prerectal spaces; the liberation of the sigmoid (see p. 179); and, if an artificial anus is to be made, its construction at this time. If, however, the bowel is to be drawn down to the anus its severance above the seat of the disease, as well as below, should preferably be left to be effected through the posterior wound. If it be desired to complete the enucleation of the rectum down to the anus through the abdominal approach rather than through the posterior one, there should then be added to the foregoing steps, the tying off of the middle hæmorrhoidal vessels (L R Fig. 13), when

present, close to the bowel, and the division of the fold of fascia propria recti (*q r* Fig. 13), lateral to the prerectal space, which is reflected onto the side wall of the vagina, and, as well, the division of the median septum (M S Fig. 5).

II. *Wide local excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor by the *combined* posterior and abdominal *routes*.

The description of this proposed operation is in the order in which the dissections were made, though the approved technique would rather be to begin above and finish below.

1. Posterior approach with division of the posterolateral fascial attachments of the fascia propria recti and the lateral attachments of the rectum and vagina, close to the pelvic wall (Figs. 1 to 9, 12, and 15 to 17). Employ the same technique as that for close local excision of the rectum alone corresponding to the steps illustrated by Figs. 1 to 7. Then divide the entire line of attachment (Fig. 8 *l m x n*) of the fascia propria recti to the pelvic wall. *l m* is torn through with the finger, thereby entering the sacrosciatic space (Ss S Fig. 9). The fibrous cord *m* is hooked up and cut, *m x* is cut along the upper border of the lesser sacrosciatic ligament and then the finger making firm forward pressure over the spine of the ischium pushes its way through into the vesicoparametrio-pelvic space (Vp P S Figs. 9 and 34, and text of Fig. 34), from which position when forced downward, it tears away the line of attachment *x n* of the fascia propria recti to the fascia covering the upper surface of the levator ani as well as the attachment (*w a* Fig. 16) immediately in front of *x n*, of the posterior border of the parametrium (see p. 192) to the white line. When this fascial separation at the pelvic wall has been completed, the appearance is similar to that shown on the left side of the dissection in Fig. 9. Isolate the lower portion of the parametrial attachment (L S Figs. 9 and 15) to the pelvic wall, containing the laterally entering arteries and nerves to the rectum and the vagina, by effecting a line of cleavage through the attachment at a depth corresponding above to the deepest point of the sacrosciatic space and below to a point half an inch deeper than the spine of the ischium, at which situation the structure is generally thinned, consisting of two fascial layers. This line of cleavage should lie below the vesicovaginal vein (Fig. 17). To perforate the thinned area, first scratch through the lower layer of fascia with the point of a knife, and puncture the upper layer. Enlarge the opening inward and downward by tearing. Divide L S between a clamp applied centrally (Fig. 16) used as a holder, and a transfixion ligature close to the pelvic wall, tied first around half the tissue and then around the whole of it, or, first cut into the lower portion of L S, consisting of the nerves and fascia, and then reach up and tie the portion above containing the vessels.

2. The exposure of the ureters (Figs. 18 to 24). Fig. 18: Expose the prevaginal space and parametrium and make the incisions through the fascia at *y z* directly onto the vaginal wall, and at *a b* down to the posterior peritoneal layer of the broad ligament. Fig. 19: Through *y z* blunt separation outward and a little backward, hugging the lateral vaginal wall made taut by traction with a clamp, opens up the fascia-lined ureterovaginal space (Figs. 29, 30, and 33 Uv S), thereby raising the vesical end of the ureter lying under its fascial covering, from the vaginal wall. Through the incision *a b* the posterior peritoneal fold of the broad ligament is stripped backward from the parametrium lying in front of it, in doing which the tissue containing the ureter should be carefully pushed outward into the outer wall of the space (Fig. 20), here called the the retroparametrial opening (Rp O), thus opened up. The incision *d e* (Figs. 19 and 20) is made in the posterior fascial layer of the parametrium to enter a plane of cleavage (ureteral compartment of the parametrium, Fig. 21) just beneath the fascia supporting the uterine artery and internal to the ureteral sheath. The opening up of this plane can be done with a scalpel handle which, carefully hugging the vaginal wall, strips outward from it the adjacent tissues containing the ureter in its sheath. Should the separating instrument follow the uterine artery instead of the vaginal wall, it would then pass across the front of the ureter to its outer side, leaving the central connections of this portion of the ureter undisturbed. Isolate the uterine artery together with the fascia in which it lies (Fig. 20),

and divide it between two ligatures (Fig. 21). Sever the raised fascial bridge (*j*) under which the stick is laid. Isolate the tissue (Fig. 22 VAG VE) containing the vaginal veins together with the lower portion of the fascial layer *g* on which they lie by passing the finger through the ureterovaginal space into the vault below, made by the operation through the posterior wound (Fig. 23 *hook*), and back again through the fascial plane *g*. Sever this tissue between two ligatures, which opens into the vault below (Fig. 24). Cut the remainder of the facial plane *g*.

3. Opening of the pelvic retrointestinal plane of cleavage (Figs. 25 and 26 and text Fig. 25, cf. also Fig. 33). Incise the peritoneum (*j k*) along the left side of the fifth lumbar vertebra and promontory thereby exposing the terminal branches of the inferior mesenteric artery. Then carefully tease an incision (*l w*) along the right side of the superior hæmorrhodal artery, through the cellulofibrous layer of tissue (vascular bowel layer V B L) in which this vessel lies, to enter the pelvic retrointestinal plane of cleavage between this layer and the fascia propria recti (FASC P R) underlying it. Care should here be taken not to injure the left iliac vein (Fig. 26). Open up this plane of cleavage laterally on either side out to the ureter at the brim, and downward as far as separation of the tissues can be effected, which is usually to the tip of the sacrum (Fig. 33), though it may be only as far as to the middle of this bone (Fig. 25). In either condition grab the fascia propria recti with a long-handled forceps at the front of the sacrum and scratch through it to enter the retrorectal space (RR S), which in the latter figure had been already opened up below by the posterior dissection. Ligature and divide the superior hæmorrhoidal vessels.

4. Severance of the lateral peritoneal attachments (Figs. 25 and 27). The remaining peritoneal attachments of the rectum, uterus, and vagina can now be gathered upon the finger passed from behind through the retrorectal space, and when the round and infundibulopelvic ligaments have been tied, can be severed in the line *n o p* (Fig. 25) the result of doing which is shown in Fig. 27.

5. Liberation of the sigmoid flexure (see "A technique for the liberation of the sigmoid fiexure," p. 181).

6. Completion of the technique. By downward pressure along the vagina, through the lower angle of the incision *h i* (Fig. 29) in the floor of the ureterovaginal space, open up the lateral vesicovaginal space (Fig. 31 L V–v S), the posterior wall of which consists of a plane of parametrial tissue (Fig. 31 *n*) connecting vagina and bladder, which tie and sever. Then cut the fascia (Fig. 31 *o p*) across at the base of the prevaginal space, thereby freeing the base of the bladder so that it can be stripped downward from the vaginal wall about three-quarters of an inch farther. Cut the vagina transversely across in front at a low level and then downward on either side and finally transversely through its posterior wall opposite the anorectal junction. The tumor is removed through the posterior wound, and the appropriate disposition made of the bowel ends (see "The question of rectal resection," p. 121). The peritoneal flaps can be brought together so as to form a diaphragm over the upper portion of the pelvic cavity, provided the peritoneum has not been cut too widely along the sides of the bowel.

III. *Wide local excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor entirely by the *abdominal route* (Figs. 28 to 32 and pelvic retrointestinal plane of cleavage, Fig. 33).

For abdominal approach employ the Stimson-Pfannenstiel incision (see p. 133).

1. Opening up of the pelvic retrointestinal plane of cleavage and entrance through it to the three recesses on either side. Open up the pelvic retrointestinal plane of cleavage (see text Fig. 25) out to the ureters laterally, and downward as far as separation can be effected, and enter the retrorectal space, as described under step 3 of operation II. In order to secure ample room for the deep manipulations through this plane of cleavage, the peritoneal opening is enlarged downward in a line about one inch to the right of the bowel or distal to the lateral limit (Fig. 29 *y*) of the vascular bowel layer. Through this approach the recesses on the two sides are now to be opened up by boring with the finger.

The lowest or *inferior recess* (see text Fig.

33) lies within the posterolateral rectal space, the track being made just below the fascial attachment *l m x* Fig. 8 of the rectal sheath to the pelvic wall, which encircles the base of the attachment (Fig. 9 L S) of the parametrium to the pelvic wall. It is opened up by introducing the finger downward into the retrorectal space (Fig. 33 to PL R S) to below the level of the fourth sacral foramen, and then pushing it outward below the fibrous cord *m* Fig. 8, thereby tearing away the V-shaped lower extremity of the lateral attachments of the fascia propria recti to the sacrum, and entering the posterolateral rectal space (see text Fig. 4) within which latter the finger then follows the lesser sacrosciatic ligament out to the spine of the ischium where the limit of this recess is reached.

The next or *middle recess* (Fig. 32 *hook* and Fig. 33 *hook* 1) is one, the opening up of which splits the parametrial attachment to the pelvic wall into an upper portion containing the laterally entering vessels, such as are present, and a lower portion consisting of a tough fibrous structure attached to the sacrum, containing the third and fourth sacral nerve connections with the pelvic plexus of the symphathetic (Fig. 12). This recess is approached through the sacrosciatic space which it first entered through the retrorectal space (Fig. 33 to Ss S) by tearing up the fascial attachment (*l m* Fig. 8) of the fascia propria recti to the sacrum. The finger then, from within the sacrosciatic space beneath the fascia propria recti, opens up the channel of cleavage below the vessels by boring in a direction from the second anterior sacral foramen downward to the spine of the ischium, at which latter bony point the limit also of this second recess is reached.

The third or *superior recess* (Fig. 28 *z*) is opened by first pulling taut the sympathetic nerve trunk lying in the fasica propria recti which has been raised from its location over the sacrosciatic space, and then pushing the finger through the tissues (*z*) just anterior to it, which raises the peritoneum of the cul-de-sac lateral to the bowel away from its deep connections, in a line for severance. The nerve trunk is easily detected as a tense cord when traction is made on the raised fascia propria recti. At its fore part this recess connects with the retroparametrial opening (RP O Fig. 29).

The primary loosening up of the rectum from its posterior connections as here detailed, enables the uterus to be lifted an inch or two higher in the pelvis, elevating at the same time the whole central pelvic contents which facilitates the dissection of the peripheral attachments of the mass to be removed.

2. The exposure of the ureters. The technique is similar to that described in the proposed operation II. In this third proposed operation, there having been no preliminary dissection from below, the vaginal veins (Fig. 29 VA VE) are raised off from the fascial layer *g* before tying.

3. Severance of the lateral peritoneal attachments. Tie and cut the round and infundibulopelvic ligaments and divide the posterior peritoneal layer of the broad ligament transversely across below the ovary (Fig. 29). Then sever the remaining peritoneal attachments along the rectum, vagina, and uterus in the line of the superior recess and retroparametrial opening. The line of severance along the bowel can be made closer on the left side than on the right, since the vascular bowel layer projects little in the former direction. When the peritoneum thus cut has been retracted, the parametrium lying below the ureter, still to be freed (Fig. 30), is exposed.

4. Division through the parametrium lying below the ureter (Figs. 30, 31, and 32). Make an incision (*h i* Fig. 29) through the outer part of the fascial floor of the ureterovaginal space, extending its whole length. By blunt entrance through this opening find the lax, resistant, vessel-carrying, fascial layer (Fig. 30 *e*) beneath, which pick up and tease through near its attachment to the bladder, thereby effecting an opening which should lie between the vaginal artery and the inferior vesical vessels (Fig. 33), leading directly into the vesicoparametriopelvic space (see text Fig. 34). Pass the finger through this opening directly backward in the latter space, for about one inch, at which depth the spine of the ischium will be found, over which firm backward pressure will push through the fascia (at *x'* and *w* Fig. 16) attached about it, into the posterolateral

rectal space, thus establishing communication with the inferior recess (see step 1) made from behind through the retrointestinal plane of cleavage, which completes the circuit of the lateral attachment of the rectum and vagina to the pelvic wall (Fig. 30 *hook* 2). At this point in the technique, downward stripping from the spine of the ischium, with the finger introduced into the fascial opening between the vesicoparametrio-pelvic and posterolateral rectal spaces, will detach the fascial attachments *x r* and *w a* Fig. 16 to the pelvic wall thereby throwing the two spaces into one.

In freeing the parametrial attachment L S to the pelvic wall, first split off the top layer of fascia (Fig. 30 *hook* 1) supporting sympathetic nerve branches to the vagina and divide it. Now, with the finger in the middle recess (Fig. 32 *hook*) made from behind, below the laterally entering vessels, draw the overlying vessels (if present) taut, strip the cellular tissue away from them with forceps, and when thus isolated by dissection tie them. The base of this parametrial attachment to the pelvic wall, which now remains, consisting of the branches of the third and fourth sacral nerves to the pelvic plexus of the symphathetic (Fig. 12) and a firm fascial connection to the sacrum, can then be hooked up over the finger and severed, probably without danger of hæmorrhage. In this dissection it will be noted that the inferior vesical vessels have been left in situ beneath the ureter (Fig. 32 INF VES VS). There now remains to be severed a lower fascial fold of parametrium (Fig. 31 *n*) containing a plexus of veins and connecting together the base of the bladder and side of the vagina. To isolate this fold push with the finger downward along the side wall of the vagina through the incision *h i* Fig. 29 in the fascia lining the ureterovaginal space. This opens up a deeper plane of cleavage (lateral vesicovaginal space Fig. 31) between the base of the bladder and the side of the vagina, forming the posterior boundary of which is the fold in question, which should be cut after tying between two ligatures.

5. Completion of the technique. Cut across the fascia (*o p* Fig. 31) lining the prevaginal space at its lower limit and strip the bladder forward from the vagina below this fold as far down as possible, which will be about three-quarters of an inch. Then cut the vagina across the front low down and thence longitudinally down the sides, after which the posterior vaginal wall can be cut across above the level of the internal sphincter, thus isolating the bowel completely for its severance at this site. Liberate the sigmoid flexure as described on p. 181, and treat the bowel ends as the conditions permit (see p. 121). The peritoneal flaps can be brought together to form a diaphragm across the cavity of the true pelvis, provided the serous coat has not been cut too widely along the sides of the bowel.

IV. *Wide radical excision of the rectum, uterus, and part of the vagina, en masse*, above the pelvic floor, with *removal of the regional glands*, entirely by the *abdominal route*. (Theoretically the operation of choice.)

For abdominal approach employ the Stimson-Pfannenstiel incision (see p. 133).

Steps 1, 2, and 3, are the same as in operation III, after performing which the anatomical picture which presents is that shown in illustration 33. This illustration shows a similar anatomical arrangement of the parametrium to that in Fig. 30, but it indicates a method of wider removal of the parametrium for disease than does the latter.

4. Division through the mobile portion of the parametrium close below the ureteral sheath and base of the bladder, and through the fixed portion close to the pelvic wall. The method here recommended is illustrated in Fig. 33. At a site close behind the ureteral sheath just below a line drawn across the ureter at the situation of the uterine artery, make an incision *q r* in the thin fascia, parallel to the ureter. Through this fascial opening by blunt separation push backward the inferior vesical vessels (INF VES VS) from the ureteral sheath thereby gaining entrance into the vesicoparametrio-pelvic space (see text Fig. 34). Press outward through the fatty contents of the space with the finger until the smooth pelvic fascia is reached, and, finding in the vicinity the bony anterior margin of the great sacrosciatic notch or the posterior edge of the obturator internus muscle overlying it, follow this with the finger obliquely backward and downward for about an inch, to a point where the spine

of the ischium is reached. The ischial spine may also be located in the course of a perpendicular line let fall from Gimbernat's ligament into the pelvic cavity at a distance of about four inches from the great vessels at the brim. Now, by backward and downward pressure with the finger against the spine of the ischium, tear through the fascial attachments (*x'* and *w* Fig. 16) about this bony point, opening through into the posterolateral rectal space and thus joining with the lowest recess (Fig. 33, [to PL R S]) approached through the pelvic retrointestinal plane of cleavage. Thus there is established a continuous channel of cleavage around the base of the lateral parametrial attachment of the rectum and vagina to the pelvic wall.

The next opening to be made in the parametrium is through the incision *h i* (Fig. 33) in the outer part of the fascial floor of the ureterovaginal space, extending its whole length, just below the base of the bladder. By blunt entrance through this fascial incision separate back the lax, resistant, vessel-carrying, fascial layer (*e*) beneath, which pick up and tease through near its attachment to the bladder, thereby effecting a second opening leading directly into the vesicoparametriopelvic space, which should lie between the vaginal artery and the inferior vesical vessels (INF VES VS). Between this opening and the one *q r*, tie off the intervening parametrial tissues attached along the base of the bladder and ureter, including the inferior vesical vessels in one or two masses (Fig. 33 *hook 2* and ligature). To reach the parametrial attachment (*n* Fig. 31) connecting the vagina to the base of the bladder below the ureterovaginal space, which is a continuation downward of the vessel-carrying layer (*e* Fig. 33), strip bluntly behind the fascia in which the incision *h i* was made, downward along the vaginal wall, which will open up a space, here called the lateral vesicovaginal space (Fig. 31 L V–v S), the posterior wall of which is formed by the layer sought for, which should be severed after having first been tied. When the mobile portion of the parametrium has thus been freed along its attachment to the ureteral sheath and base of the bladder, thereby opening widely into the vesicoparametriopelvic space, then the portion fixed to the pelvic wall behind the ureter, which is that containing the arteries and nerves entering the rectum and vagina laterally, designated as L S in the illustrations, can be more easily dealt with. It is now that the middle recess (Fig. 32 *hook*, and Fig. 33 *hook* 1), is utilized for the introduction of the finger to raise on it the upper vascular part of the parametrial attachment to the pelvic wall, when the vessels thus made taut are stripped of their associated connective tissues and tied and cut. If isolation of the vascular structures be attempted at a site higher in the pelvis than the middle recess, the main arterial trunk will be caught up above the origin of the internal pudic, which if tied would then necessitate the subsequent ligature of the internal pudic near where it leaves the pelvis, in order to free the central mass. As the internal iliac vein is exposed a gland should be looked for opposite the second sacral foramen. In isolating the laterally entering vessels, the prolongation of the fascia propria recti from the pelvic wall over the posterior aspect of these structures should be first split off and severed from its pelvic connections. This cuts in two the sympathetic nerve trunk from the hypogastric plexus. After the vessels have been tied and severed the lower fibronervous part of the parametrial attachment to the pelvic wall is hooked up over the finger passed through the inferior recess, and severed. The fascial connections (Fig. 16 *w a*) of the posterior border of the parametrium to the white line at the bottom of the vesicoparametrio-pelvic space, and lying adjacent to it, that (Fig. 16 *x' r*) to the fascia covering the levator ani, are now split off by pressure directed downward from the spine of the ischium (cf. text Fig. 8, entrance to VP–P space), and the posterior median septum (Fig. 5 M S) below the tip of the sacrum is divided, thereby completing the isolation of the rectum and vagina down to the insertion into them of the fibers of the levator ani.

5. Division of the fascia above the ureteral sheath (Fig. 33 *director s t*), thereby completing the isolation of the ureter in its sheath and rendering accessible for dissection the fatty and glandular contents of the vesicopara-

metrio-pelvic space (Fig. 34), which are then removed. Isolate the fascia suspending the ureter and bladder from the edge of the iliac fossa by passing the finger into the opening (*q r* Fig. 33) beneath the ureter, and sliding it upward external to the ureteral sheath, when it will appear beneath the thin fascia above, which it has raised from the underlying cushion of fat. Incise this fascia in the line *s t*, cutting above the uterine artery and going backward to a point well behind the latter to expose the bifurcation of the common iliac artery, thus opening up to view the glandulo-fatty contents of the vesicoparametrio-pelvic space. The outer portion of the uterine artery giving branches to the ureter is thus preserved. Dissect the anterior and internal chains of glands off from the external iliac vessels, beginning in the middle of their course and carrying the dissection from without inward to beneath the external iliac vein, where a mass of glands and fat is found around the obturator nerve, loosely associated with the pelvic wall. Tease off the posterior connections of the glandulo-fatty contents of the space along the internal iliac artery, looking for a gland at the bifurcation of the common iliac artery, and then strip the whole mass downward from off the smooth pelvic fascia up to its anterior connections, which are tougher and more closely associated with the vessels and the bladder, and therefore more difficult to detach. Cleavage between the glandulo-fatty tissue and the bladder is effected by incising (*v y* Fig. 34) the fascia along the inner side of the obliterated hypogastric artery (O H A) near its reflection onto the abdominal wall and then pushing backward with the finger through this opening across the horizontal ramus. This likewise hooks up the fascial fold attaching the mass to the lateral aspect of the top of the bladder, which can be cut, a sound being introduced into the bladder to prevent its injury in case the line of junction of the fascia with the bladder cannot be distinctly felt. In severing the remaining anterior connections it is to be remembered that one fascial offshoot from the glandulo-fatty mass is in relation with the deep epigastric artery, and another in relation with an obturator artery, when present, taking its origin from the external iliac. Conclude the dissection by removing the firmly attached prominent row of glands lying in front of the external iliac vessels along Poupart's ligament and running off internally over the horizontal ramus. The genitocrural nerve (GEN CR N) should be avoided where it enters the glandular mass in front of the external iliac artery. The external chain of the external iliac glands lies in the sulcus between the external iliac artery and the psoas muscle, separated from the other chains of these glands by a distinct covering of deep fascia, and is probably not so liable to involvement as are the latter chains.

6. Completion of the technique. This is the same as that for operation III.

### RETRORECTAL INCISIONS

The pioneer in rectal extirpation, Kraske, and Hochenegg quickly following him, are the men who have done the work in the development of the method of posterior approach to the rectum, which has stood the practical test of experience. The cardinal principles as regards bony removal in retrorectal approach were early enunciated by Kraske (154), who put forward the propositions that bony removal should be regulated by the anatomic conditions which favored or impeded access to the rectum; that where bony opposition to access could be sufficiently overcome by a simple disarticulation of the coccyx, then no further removal of bone should be practiced; that in resection of the sacrum the fourth sacral nerve of one side could be sacrificed without impairment of sphincteric or bladder functions; and that only in cases of extreme necessity should the sacrum be cut transversely across below both of the third sacral foramina. He decried one operator's proposition to make a general practice of sectioning the sacrum at the latter situation and regarded as a surgical error another's enjoinder to resect at the second sacral opening. He urges that osteoplastic resections of the sacrum, done with a view to their primary closure, are ill-advised, since from the drainage which must always be instituted in the wound, or in the presence of caries resulting from the discharges, the only sort of union of the bones that can be hoped for is by granulation.

Fig. 14 shows the third and fourth sacral

nerve roots which furnish the branches to the muscles of the pelvic floor and perineum and are consequently of importance to save. It should also be borne in mind in connection with sacral resection that hernia may occur as a sequel of extensive bone removal. The writer has seen one such case.

The size of the pelvic outlet as affecting the choice of a suitable posterior incision of approach to the rectum is of importance. In females the outlet is larger than in males, the distance between the tip of the sacrum and the anus is consequently greater, and it is particularly in their sex that simply an incision through the soft parts with disarticulation of the coccyx gives ample space through which to resect the rectum. The type of sacrum usually found by the writer in anatomical work was one in which a narrowed lower extremity, consisting wholly, or chiefly, of the body of the fifth sacral vertebra, projected downward an inch or more below the level of the lateral sacral angles. By knocking off such projecting piece through the approach by the horseshoe incision, or that described in Figs. 36 and 38, there was always secured ample room for manipulation of the bowel. On one cadaver, however, the lateral sacral angles extended very low down toward the anus and there was no central piece of bone projecting below them, also the ischial tuberosities were very closely set together and the lower borders of the great sacrosciatic ligaments deviated outward but little from a vertical direction, so that the usually available space of the outlet was here very much compromised, and it was estimated that in this case the room that could have been gained by any one of the approved retrorectal approaches, unless possibly one cutting the sacrum across below both third foramina, would have been inadequate to permit through it the performance of the steps of rectal excision. Johae (155) describes sacra with and without a sharp turn inward of the lateral margins of the bone around the fourth sacral foramen, the former class being that in which the laterally projecting bone would require resection in Kraske's method. Johae has studied the procedure for determining the size of the pelvic outlet before operating. For the accomplishment of this object he recommends especially measuring the distance from the tip of the sacrum to the tuber ischii. Anatomical conditions corresponding to a goodly length of this distance are a short sacrum and a deep pelvic cavity. The width of the transverse diameter of the outlet should also be obtained. This can be gotten by direct measurement between the tuberosities of the ischium, or a general estimate can be formed as to whether or not this space be unduly narrowed from a measurement of the distance between the posterior superior spines of the ilia. To measure the transverse diameter Breisky put the patient on his back, raised the hips, and moderately abducted and flexed the thighs while the feet rested on the table. Carfunkle estimated this distance normally at a maximum of 10.8 cm. and a minimum of 8 cm., making a maximum addition of 2 cm. and a minimum of 0.8 cm. allowance for soft parts. An abnormally small measurement between the posterior superior spines of the ilia would suggest a transverse narrowing of the pelvis. Skutsch found for normal pelves this measurement was 10.2 cm. and for pelves narrowed transversely, 8.5 cm. and under. Johae has propounded the proposition that the deeper the anterior sacral concavity, the greater the size of the spaces lateral to the sacrum, i. e., between the sacrum and the ischia. He advises rectal examination to determine the sacral curvature, the shape of the lower portions of the lateral edges of the sacrum, and the situation of the sacrococcygeal joint. The writer would suggest the use of the X-ray to determine the shape of the lower portion of the sacrum in cases of doubt.

To emphasize the comprehensiveness of Kraske's method of posterior approach to the rectum, as well as the effectualness of Hochenegg's modifications, it has seemed most fitting to here recant these procedures from the words of these investigators themselves. The advantage of the methods of these surgeons over those of others is, that starting with a simple incision of the soft parts, the size of the opening is capable of extension to a greater or less degree to conform to the requirements of the case.

*Kraske's* (156) *retrorectal approach.* The idea of utilizing a parasacral incision in the

soft parts was taken by Kraske from Hochenegg. The patient is put on the right side with knees drawn up. The incision begins at the level of the middle of the sacrum about two to three finger breadths to the left of the median line, passes in a slight curve concave to the left, as far as the coccyx, and thence continues in the median line to a point a finger's breadth from the anus, where it terminates. In the upper part of the wound the lower fibers of the gluteus maximus muscle are cut across, and in the lower part, the fat of the ischiorectal fossa. As the gluteus fibers are cut and retracted, there are exposed in the bottom of the wound the greater and lesser sacrosciatic ligaments which are cut through. The branches of the inferior gluteal artery exposed by division of the muscle fibers are tied. When the ischiorectal fat has been cut through, the levator ani muscle, enveloped by its upper and lower coverings of fascia, and the coccygeus muscle are exposed. This diaphragma pelvis is now cut through layer by layer for the whole extent of the wound. The coccyx is bared on its posterior surface and right side, and disarticulated. Firm pressure close to the front of the sacrum raises the tissue containing the sacra media artery which is ligatured. The loose cellular tissue between the fascia covering the upper surface of the levator ani and the fascia propria recti is now torn asunder with the finger, which exposes the rectal area under cover of the latter fascia. For many cases the approach is thus completed. Often the impediment to access is caused by a too great lateral projection of the sacrum toward the ischium, encroaching on the sacroischiadic space, in which case a resection of the lower part of the left wing of the sacrum should be added, after having first raised from it the overlying soft parts. This line of section begins at the left margin of the bone on a level with the lower border of the third posterior sacral foramen, passes in a curve, concave to the left inward and downward mesial to the left fourth sacral foramen which is thus cut away, as far as to the lower sacral horn. "In particularly difficult cases," Kraske says, "I have no hesitation in cutting the os sacrum transversely across at the level of the lower margins of the third foramina."

*Hochenegg's* (157) *modifications.* These were the parasacral incision, and the sectioning of the sacrum in a line below the left third and right fourth foramina, the latter done as a trial procedure to secure added room, before resort should be had to the more mutilating transverse section above both fourth sacral nerve roots. Hochenegg places his patient on the left side instead of the right. The course of his parasacral incision is a little different from Kraske's adaptation of it. Starting opposite the middle of the left sacroiliac joint the incision passes across the median line to the right edge of the coccyx, describing in its course a curve convex to the right, and ends just below the coccyx. When the anus is to be removed the incision continues downward in the median line until the anus is reached, and then divides into two arms which, embracing the latter, meet in front of it. As the soft parts are retracted there are exposed in the bottom of the wound the left half of the sacrum, the whole of the coccyx, and the median portion of the sacrosciatic ligaments. The tissues are divided laterally, the coccyx removed, and the deep parts palpated to judge the amount of bone removal necessary. Hochenegg stated that in most cases the simple removal of the coccyx did not give sufficient space. Hochenegg's division of the sacrum takes off the lower part of the left wing as removed by Kraske's cut, and in addition the whole projecting lower extremity of the bone below the right inferior lateral angle. This furnishes a far more spacious approach than can be secured through Kraske's lateral section of the sacrum alone.

*The retrorectal approach by the horseshoe flap* with median division of the deep structures, pictured in the first few illustrations of this article, by its primarily removing a thick layer of overlying tissues, does away with the restraint of the same on the retraction of the deep wound and thereby facilitates access to the rectum. The reflection with the flap of the posterior fibers of the external sphincter, severed from their coccygeal attachment, removes an especial restraint to saggital stretching of the deep wound. In the female cadver through this approach with resection of the coccyx only, the writer has been able to tie off close to the pelvic wall the bases of the parametrial attach-

ments (L S Fig. 9) to the latter, though the height to which it was necessary to reach made the manipulations a little awkward.

Though this approach, with simple removal of the coccyx, was used in the case here reported and afforded very ample room, yet not being adapted for good drainage it cannot be recommended for rectal resection. In operating for prolapse of the rectum the writer has employed it satisfactorily.

Duret (158) reports a case of resection of the rectum with circular suture of the bowel ends operated upon by the combined method, in which he made a U-shaped skin incision for access to the posterior approach. The tip of the U encircled the coccyx and the arms were directed toward the ischiorectal fossæ. The deep structures of the perineum were divided by a Y-shaped incision, the upright of the Y being in the median line and the two arms branching anteriorly around the posterior half of the anus. There was no bony removal. No mention is made of drainage.

*A proposed retrorectal approach* (Figs. 36, 37, and 38). The writer proposes a retrorectal approach which does not mutilate the nerves, can secure access to both sides equally (Fig. 38), provides for good drainage, and, in those cases with outlets of limited size, as in males, in which the conformation of the sacrum is of the type having a fifth vertebral body projecting an inch or more below the lateral sacral angles, should permit of the performance of all the operative procedures which ought to be done by this route. It contemplates the production of a broad, rather than a high exposure of the rectum. If it be conceded that the removal of a high rectal growth with ligaturing of the superior hæmorrhoidal vessels and handling of the sigmoid colon should not be attempted entirely from below, the operative procedures for which the posterior route should be used would seem to resolve themselves into those for (*a*) completion of rectal extirpation in the combined operation, (*b*) local excision of an ampullary growth not necessitating the ligature of the superior hæmorrhoidal vessels, (*c*) bowel anastomosis above the anus, and (*d*) drainage.

The subject on which the dissections for Figs. 36, 37, and 38 were made, was a male with an outlet of limited size, in whom the sacrum was of the type having a narrowed lower extremity projecting well below the lateral sacral angles, and was particularly selected for having a short coccyx with its tip situated very near the anus.

*Technique of proposed retrorectal approach.* With the patient on the left side, an incision is made in the median line from the fourth sacral vertebra to the upper part of the coccyx, then it turns diagonally over the right edge of the coccyx, avoiding the attachment of the external sphincter at its tip, and enters the fat of the ischiorectal fossa, after which it is continued superficially downward and a little outward to the right, parallel with and a little external to the fibers of the external sphincter to terminate for the moment at a point just lateral to the posterior margin of the anal canal, which point is directly opposite the site of entry of the inferior hæmorrhoidal nerve branches into the external sphincter, lying about one inch beneath the skin surface. The *director* in Fig. 36, placed closely against the posterior median line of the anal canal indicates the line in which these nerves are found. To avoid injury to these nerves in dividing the deep tissues, the finger first finds the anal fascia by dissecting through the fat in the angle at the tip of the coccyx, between the gluteus maximus and the external sphincter, and then by pushing along the anal fascia downward toward the anus, splits off the ischiorectal fat until cleavage is arrested by restraining tissues (site of small artery Fig. 36). After division of the latter, the nerves may be exposed by first stripping forward along the fascia covering the external sphincter, beneath which the nerves lie, and then dissecting vertically upward through this fascia in the course of the nerves themselves, which latter may be made prominent by downward traction on the sphincter. An arched skin incision (*l m* Fig. 36) is made across the summit of the longitudinal one and the skin flaps thus outlined are reflected a sufficient distance from the surface of the glutei maximi muscles to allow lateral splitting and retraction of the deep structures.

The further steps of approach to the rectum through this opening of entrance depend upon whether (1) ***disarticulation is to be made at the sacrococcygeal joint*** (Fig. 37), or (2) ***transverse***

*osseous division through the sacrum just below its inferior lateral angles* (Fig. 38). If the former, the attachment of the right gluteus maximus fibers to the right edge of the coccyx is first severed (Fig. 36). The finger can then be hooked beneath the tip of the coccyx to move the bone, thereby discovering the site of its articulation with the sacrum. Then disarticulate the coccyx (see text Fig. 3), dissect it from its anterior connections approaching from the right side, and swing it to the left on the uncut tissues of the left side as a hinge, or remove it entirely. Just in front of the coccyx is a dense structure in which lie the terminations of the sacra media and lateral sacral arteries, which vessels can be preserved from injury by dissecting close to the anterior surface of the bone. This precoccygeal structure, triangular in outline, above has a close attachment to the front of the sacrum, laterally on either side receives the insertion of fibers of the coccygeus muscle, and below supports the median aponeurosis uniting the levatores ani. Its transverse division (*e f g*) is of importance to relieve the restraint to lateral retraction of the flap exercised by it in conjunction with the tough median aponeurosis between the levatores ani.

The deep muscular incision *c e d* Fig. 36 is now made, which opens the right posterolateral rectal space (see text Fig. 4). In making this incision the dense structure in the bottom of the space from which the coccyx was removed and the fascia underlying it should be cut through first, and then the finger introduced through this opening into the right posterolateral rectal space(Fig. 37), in a downward direction raises the right levator ani for severance, and in an upward direction separates forward the rectum and its covering or fascia propria from the front of the lesser sacrosciatic ligament until it reaches the attachment of the latter to the inferior lateral angle of the sacrum. At the latter situation the margin of the bone is thinned and curves around below the fourth sacral foramen forming the base line of the lateral mass, which is directed transversely and is the guide to the upper limit of the incision *e c* Fig. 36. Below the level of the lateral sacral angles a narrower terminal portion of the sacrum, consisting of a fifth sacral vertebra body and sometimes the lower portion of the fourth, usually projects downward an inch or more, along either side of which are attached fibers of the gluteus maximus muscle, part of the lesser sacrosciatic ligament, and part of the coccygeus muscle with the fascia underlying it, which structures are the ones divided by the incision *e c*. When the incision *c e d* has been completed, starting at the upper limit of severance opposite the lower margin of the right lateral sacral angle, the deep structures are then split outward toward the spine of the ischium, and the flap thus freed is pulled to the right, thereby opening widely the right posterolateral rectal space. In the lateral splitting of this deep flap as the lesser sacrosciatic ligament is cut, the greater sacrosciatic ligament is met (Fig. 37) crossing it obliquely, which should not be severed but instead should have the fibers of the gluteus maximus cut from its posterior surface. In making the portion *e d* of the deep incision through the right levator ani, the line of division passes into the right ischiorectal fossa and can be carried together with the skin incision beyond the line of the inferior hæmorrhoidal nerves, if the latter have first been dissected out for their avoidance. The left posterolateral rectal space is now entered by pushing the finger from the right space across to the left side at a level just below the tip of the sacrum and then, hooking the finger downward into the left space, the median septum (Figs. 5 and 37 M S) is raised on it and divided, thereby throwing the two spaces into one. The dense tissue forming the floor of the area from which the coccyx was removed is then divided in the line *e f g* (Fig. 36), catching the terminations of the sacral vessels lying in it, and from the left extremity of the sacrococcygeal joint the gluteus maximus and coccygeus muscles with underlying fascia are split laterally to the left, thus affording as wide access to the left posterolateral rectal space as can be gained at this level, and completing this method of exposure of the rectum from behind (Fig. 37).

*Transverse osseous division through the sacrum just below its inferior lateral angles*, with lateral splitting of the soft parts on both sides at the same level (Fig. 38), can be

made in order to gain a higher and broader exposure of the rectum than can be obtained by resection of the coccyx alone. This higher exposure can be accomplished either as a later step to the approach shown in Fig. 37, or else preferably, without preliminary disarticulation of the coccyx, right after making the deep vertical incision corresponding to *c e d* Fig. 36, but here necessarily skirting the coccyx. The division of the bone (Fig. 37 *h i*) is made with an osteotome directed transversely, in doing which hæmorrhage from the sacral vessels is avoided by prying off the severed segment of bone from the dense periosteum attached to its anterior surface, and then cutting carefully through the latter membrane until a loosely attached tissue immediately in front of it is reached, where the vessels are found and can be readily caught and severed. This line of transverse division of the sacrum corresponds to that of splitting off of FRGT 1 on either side in Fig. 6.

*Choice of retrorectal approach.* The Kraske approach with simple disarticulation of the coccyx or with the removal in addition of a widely projecting inferior lateral angle of the sacrum below the third sacral foramen, is the preferable procedure when practicable, and would probably suffice in all female cases with broad pelvic outlets. A parasacral incision through the soft parts, with Hochenegg's method of bone removal cutting the sacrum across in a line below the left third and right fourth sacral foramina, would probably be most often applicable in the case of males with outlets of limited size in whom the sacra are of the type having a narrowed lower extremity projecting well below the lateral sacral angles. To the latter class of cases the herewith proposed retrorectal approach would also seem to be particularly applicable. Transverse section of the sacrum below the third foramina would seem to be inevitable in males where there is no projecting central bony extremity below the level of the inferior lateral angles.

## BIBLIOGRAPHY


1. FREUND. Centralblatt f. Gyn., 1881.
2. RIES. Zeitschrift f. Geb. u. Gyn., xxxii, 1895, p. 266.
3. WERTHEIM. British Medical Jour., 1905, p. 689.
4. MACKENRODT. Ergebuisse der abdominalen Radikaloperation des Gebärmutterscheidenkrebses mittels Laparotomia hypogastrica. Zeitschrift f. Geb. u. Gyn., liv, 1905, p. 514.
5. VON ROSTHORN. The radical operation in uterine cancer. Jour. Amer. Med. Assn., xlviii, 1906, p. 1872.
6. DÖDERLEIN. Abdominale und vaginale exstirpation des karzinomatosen uterus. Hegar's Beiträge ix, 1904–5, p. 173.
7. SAMPSON. Johns Hopkins Hospital Bulletin, xv, 1904, p. 76.
8. RIES. The operative treatment of Cancer of the Cervix Uteri. Jour. Amer. Med. Assn., xlviii, 1906, p. 1869.
9. VON ROSTHORN. Erfahrungen bei operation der Rezidive des Gebärmutterkrebs. Verhandl. der Deutschen Gesell. f. Gyn., xi, p. 454.
10. MACKENRODT. Laparotomia hypogastrica extraperitonealis zur Heilung der Gebärmutterscheidenkrebses und des Mastdarmkrebses. Berl. klin. Wochenschrift, 1902, p. 894.
11. PRYOR. Trans. Am. Gyn. Assn., 1900.
12. BAISCH. Arch. f. Gyn., lxxv, 1905, p. 273.
13. KERMAUNER AND LAMÉRIS. Hegar's Beiträge zur Geburtsh. u. Gyn., W. 1901, p. 87.
14. KUNDRAT. Arch. f. Gyn., lxix, 1903, No. 2, p. 355.
15. KRÖMER. Monatschrift f. Geb. u. Gyn., xviii, No. 5.
16. SCHAUTA. Monatschrift f. Geb. u. Gyn., xix, 1904, p. 504.
17. WINTER. Centralblatt f. Gyn., 1902.
18. PANKOW. Arch. f. Gyn., lxxvi, 1905, p. 417.
19. VON ROSTHORN. Discussion of this paper — Illinois Med. Jour., Aug. 1906, p. 181.
20. WERTHEIM. Surg. Gyn. and Obs., Jan., 1907.
21. MACKENRODT. Monatschr. f. Geb. u. Gyn., xix, 1904, p. 815.
22. VON ROSTHORN. Centralblatt f. Gyn., xxv, 1901, p. 588.
23. VON ROSTHORN. Jour. Am. Med. Assn., 1906, p. 1872.
24. WERTHEIM. Surg. Gyn. and Obs., Jan., 1907.
25. LORENZ. Arch. f. klin. Chir., lxiii, 1901, p. 854.
26. WINTER. Zentralbl. f. Gyn., xxviii, 1904, p. 441.
27. Report of Committee on Cancer of the Uterus. Jour. Amer. Med. Assn., xlvii, 1906, p. 1867.
28. SASSE. Deutsche med. Wochenschr., xxix, 1903, p. 769.
29. REHN. Verhandl. der deutschen Gesell. f. Chir., xxix, 1900, p. 514.
30. KRASKE. Discussion Körte. Verhandl. der deutschen Gesell. f. Chir., xxix, 1900, p. 32.
31. GOUILLIOUD AND FAYSSE. Amputation du Rectum. Rev. de Chir., xxxii, 1905, p. 107.
32. C. H. MAYO. Trans. Am. Surg. Assn., xxiv, 1906, p. 43.
33. KRASKE. Sammlung klin. Vorträge, neue folge Chir., 51–80, 1897–1900, p. 771.
34. PANKOW. Arch. f. Gyn., lxxvi, 1905, p. 347.
35. HOCHENEGG. Arch. f. klin. Chir., 1902, lxviii, p. 172.

36. PETERMANN. (Rotter). Arch. f. klin. Chir., lxxx, 1906, p. 1.
37. KÜPFERLE. Bruns. Beiträge z. klin. Chir., xlii, 1904, p. 663.
38. HARTWELL. Annals of Surg., xxxvii, 1906, p. 399.
39. HARTMANN. Discuss. Ball, Brit. Med. Jour., Sept., 1905, p. 793.
40. WOLFF. Arch. f. klin. Chir., lxii, 1900, p. 232.
41. POPPERT. Zur Frage der Erhaltung des Schliessmuskels bei der Exstirpation des Mastdarmkrebses, Müench. med. Wochenschr., liii, 1906, p. 1505.
42. KÜMMELL. Discussion Kraske. Verhandl d. deutsch Gesell., f. Chir. xxxv, 1906, p. 130.
43. QUÉNU. Bull. et Mém. de. la Soc. de Chir. de Paris, 1902, p. 812.
44. HARTMANN. Bull. et Mém de la Soc. de Chir. de Paris, xxviii, 1902, p. 877.
45. LUSK. Med. & Surg. Report Bellevue & Allied Hosps. i, 1904, p. 285.
46. ROTTER. Deutsche med. Wochenschr., xxxii, 1906, p. 1474.
47. C. H. MAYO. Trans. Am. Surg. Assn., xxiv, 1906, p. 43.
48. KRASKE. Arch. f. klin. Chir., lxxx, 1906, p. 634.
49. TUTTLE. Diseases of the Anus, Rectum, and Pelvic Colon, 1905, p. 762.
50. QUÉNU AND HARTMANN. Chirurgie du Rectum, 1899, ii, p. 120.
51. LORENZ. Arch. f. klin. Chir., lxiii, 1901, p. 854.
52. KRASKE. Samml. klin. Vorträge neue folge, 51–80, 1897–1900, p. 771.
53. HOCHENEGG. Verhandl. d. deutschen Gesell. f. Chir., xxix, 1900, p. 14.
54. LORENZ. Ibid.
55. MOULONGUET. Soc. de Med. d'Amiens, July, 1890.
56. LIEBLEIN. Bruns Beiträge z. klin. Chir., xxxiii, 1902, p. 464.
57. MAUNSELL. Lancet, 1892, p. 473.
58. TRENDELENBURG. Verhandl d. deutschen Gesell. f. Chir., 1897, p. 69.
59. KÜMMELL. Discussion Kraske. Verhandl. d. deutschen Gesell. f. Chir., xxxv, 1906, p. 130.
60. WEIR. Jour. Am. Med. Assn., xxxvii, 1901, p. 801.
61. ABBE. Annals Surg., xxxvi, 1902, p. 222.
62. MAYO. Trans. Am. Surg. Assn., xxiv, 1906, p. 43.
63. TRENDELENBURG. Ibid.
64. EDEBOHLS. Am. Jour. Obstet., xliv, 1901.
65. SCHLOFFER. Bruns Beiträge z. klin. Chir., xlii, 1904, p. 396.
66. MANN. Jour. Amer. Med. Assn., xxxvii, 1901, p. 23 (3 times through abdominal route, 2 successful).
67. CZERNY. See Küpferle, Bruns Beiträge z. klin. Chir., xlii, 1904, p. 663.
68. KOCHER AND BRAUN. Discussion Kraske, Verhandl. d. deutschen Gesell. f. Chir., xxxv, 1906, p. 130.
69. SASSE. Deutsche Med. Wochenschr., xxix, 1903, p. 769.
70. BALL. British Med. Jour., 1905, p. 793.
71. ROTTER. Deutsche Med. Wochenschr., xxxii, 1906, p. 1474. Also v. Bergmann's Surg., Bd. iii, Th. 2, 1901, p. 126.
72. KÖRTE. Deutsche Klinik, vol. 8, p. 749.
73. WÖLFLER. Verhandl. d. deutschen Gesell. f. Chir., xxix, 1900, p. 38.
74. REHN. Verhandl. d. deutschen Gesell. f. Chir., xxix, 1900, p. 514.
75. JAFFÉ. Küster, Discussion Kraske. Verhandl. d. deutschen Gesell f. Chir., xxxv, 1906, p. 130.
76. POPPERT. Müench. Med. Wochenschr., liii, 1906, p. 1505.
77. KÜPFERLE. Bruns Beiträge z. klin. Chir., xlii, 1904, p. 663.
78. CZERNY. Berlin klin. Wochenschrift, 1897, p. 779.
79. KOCHER. Chirurg. ops' lehre, 1907.
80. PRUTZ. Arch. f. klin. Chir., lxiii, 1901, p. 591.
81. KRÖNLEIN. Verhandl. d. deutschen Gesell. f. Chir., xxix, 1900.
82. v. EISELSBERG. Wiener klin. Wochenschr., xviii, 1905, p. 974.
83. KRASKE. Ibid.
84. KRASKE. Die Erhaltung des Schliessmuskels bei der Exstirpation des mastdarmkrebses und seine spätere Function. Deutsche Med. Wochenschr., xxxi, 1905, p. 1098.
85. KÖRTE. Ibid.
86. GOLTZ AND EWALD. Pflüger's Archiv., lxiii, 1896, p. 362.
87. PRUTZ. Ibid.
88. HOCHENEGG. Ibid.
89. LORENZ. Ibid.
90. SONNENBURG. Verhandl. d. deutschen Gesell. f. Chir., xxvi, 1897, p. 383.
91. KÜMMELL. Arch. f. klin. Chir., lix, 1899, p. 555.
92. SASSE. Deutsche Med. Wochenschr., xxix, 1903, p. 769.
93. ANDREWS. Matthew's Med. Quarterly, 1896, p. 303.
94. KÜSTER. Ibid.
95. BALL. Ibid.
96. KRASKE. Arch. f. klin. Chir., lxxx, 1906, p. 634.
97. DE QUERVAIN. Rev. Med. de la Suisse Romande, xxi, 1901, p. 737.
98. TRENDELENBURG. Ibid.
99. ROTTER. v. Bergmann's Handbuch d. prakt. Chir., Bd. iii, Th. 2, 1901, p. 126.
100. WENZEL. Müench. Med. Wochenschr., 1906, p. 1757.
101. JAFFÉ. Discussion Kraske. Verhandl. d. deutschen Gesell. f. Chir., xxxv, 1906, i, p. 130.
102. WITZEL. Müench. Med. Wochenschr., L, 1903, p. 417.
103. WIESINGER. Deutsche Zeitschr. f. Chir., lxi, 1901, p. 496.
104. SCHUCHARDT. Deutsche Med. Wochenschr. xxv, 1899, p. 553.
105. CZERNY. Berl. klin. Wochenschr., 1897, p. 779.
106. KRASKE. Gdnkschr. f. d. verstorb. Generalstabsarzt d. Armee v. Leuthold, Berl., 1906, ii, p. 133.

107. MOYNIHAN. Jour. Surg. Gyn. and Obs., vi, 1908, p. 462.
108. KRASKE. Verhandl. deutschen Gesell. f. Chir., xxxv, 1906, p. 130.
109. ABBE. Annals of Surgery, xxxvi, 1902, p. 222.
110. STIMSON. Annals of Surgery, xl, 1904, p. 178.
111. QUÉNU. Bull. de la Soc. Anatomique de Paris, cinquième Série, vii, 1893, p. 399.
112. GEROTA. Archiv. f. Anat. u. Physiologie, 1895. Anatomische Abtheilung, p. 240.
113. POIRIER, CUNÉO, AND DELAMERE. The Lymphatics, 1904.
114. MORAU. Comptes Rendus Hebdomadaires des Seances et Mémoires de la Société de Biologie, 1894. I, dixième série
115. TREVES. British Medical Journal, 1885, i., 582.
116. MORAU. Ibid.
117. KRÖMER. Ref. from Baisch. Arch. f. Gyn., lxxv, 1905.
118. QUÉNU AND HARTMANN. Chirurgie du Rectum, ii, p. 132.
119. MACKENRODT. Zeitschrift f. Geb. u. Gyn., liv, 1905, p. 551.
120. PANKOW. Archiv. f. Gyn., lxxvi, 1905, p. 337.
121. SAMPSON. Johns Hopkins Hospital Bulletin, xv, 1904, p. 39.
122. SAMPSON. Ibid., p. 76.
123. VON ROSTHORN. Discuss. of this paper, Ill. Med. Jour., Aug. 19 '06.
124. Journal American Medical Association, xlvii.
125. WERTHEIM. Ein neuer Beitrag zur Frage der Radikaloperation beim Uteruskrebs, Arch. f. Gyn., lxv, 1902, p. 1.
126. FEITEL. Zur arteriellen Gefässversorgung des Ureters. Zeitschr. f. Geb. u. Gyn., xlvi, 1901, p. 269.
127. WERTHEIM. Jour. Surgery, Gynecology and Obstetrics, iv, 1907, p. 1.
128. RIES. Zeitsch. f. Geb. u. Gyn., xxxvii, 1897, p. 528.
129. RIES. Discuss. this paper, Ill. Med. Jour., Aug. 1906, p. 180.
130. MACKENRODT. Ibid., p. 552.
131. BUMM. Charité Annalen, xxxi, 1907, p. 428.
132. VON ROSTHORN. Jour. Amer. Med. Assn., xlvii, 1906, p. 1872.
133. VON ROSTHORN. Discussion of this paper, Ill. Med. Jour., Aug., 1906.
134. WERTHEIM. Jour. Surg. Gyn. & Obs., iv, 1907, p. 1.
135. HARRIS. Jour. Amer. Med. Assn., 1899, p. 1450.
136. LUSK. "A Controllable Artificial Anus; Perineal Excision of Rectum with Studies on Surgical Anatomy, including an Anatomical Approach to the Base of the Bladder." Medical and Surgical Report Bellevue and Allied Hospitals, i, 1904, p. 285.
137. MACKENRODT. Zeitsch. f. Geb. u. Gyn., xxix, 1894. p. 157.
138. CHALOT. Bull. et Mém. de la Soc. de Chir. de Paris, xxii, 1896, p. 310.
139. KÜMMELL. Discussion Kraske. Verhandl. der deutschen Gesellsch. f. Chir., xxxv, 1906, i, p. 130.
140. ARCHIBALD. Jour. Amer. Med. Assn., l, 1908, p. 573.
141. CHALOT. Bull. et Mém. de la Soc. de Chir. de Paris, xxii, 1896, p. 310.
142. BALL. A Discussion on the Surgical Treatment of Malignant Disease of the Rectum. Brit. Med. Jour., Sept. 30, 1905, p. 793.
143. TREVES. Ibid.
144. KÜMMELL. Arch. f. klin. Chir., lix, 1899, p. 555.
145. ARCHIBALD. Ibid.
146. MOYNIHAN. Ibid.
147. REHN. Verhandl. der deutschen Gesellsch. f. Chir., xxix, 1900, p. 514.
148. TREVES. Ibid.
149. DOYEN. Verhandl. der deutschen Gesellsch. f. Chir., xxvii, 1898, p. 200.
150. TREVES. Lancet, 1898, p. 276.
151. KÜMMELL. Arch. f. klin. Chir., lix, 1899, p. 555.
152. DE QUERVAIN. Ibid.
153. ARCHIBALD. Jour. Amer. Med. Assn., l, 1908, p. 573.
154. KRASKE. Samml. klin. Vorträge Neue Folge. Chir. 51–80, 1897–1900, p. 771.
155. JOHAE. Beiträge f. klin. Chir., x, 1893, p. 755.
156. KRASKE. Ibid.
157. HOCHENEGG. Wiener. klin. Wochenschr., i, 1888, p. 254.
158. DURET. Bull. de l'Academie de Médecine, xlviii, 1902, p. 453.

# HERMAPHRODISM

## Report of a Case

By GEORGE BEN JOHNSTON, M. D., Richmond, Virginia
Professor of Abdominal Surgery, Medical College of Virginia

HERMAPHRODISM is defined as the bisexual development of one individual. It is divided into true hermaphrodism, in which both male and female organs of generation coexist in a single individual; and false hermaphrodism, in which the genital organs of an individual appear more or less like those of the opposite sex. It is said that a perfect true hermaphrodite, with functionally active glands of both sexes, has never been discovered in the case of human beings, although this conditions occurs in lower animal and plant life. Instances of false hermaphrodism are not very uncommon, and are due to congenital defects of the structures that form the external genitalia. In addition to these two classes, there is a third group of cases which may be termed partial hermaphrodism, in which an individual possesses some, but not all, of the organs common to both sexes. It is just such a case as this that I wish to report.

*Partial hermaphrodism; male with uterus masculinus, Fallopian tubes, and ovo-testes.*

S. W. S., age 23; white, married; of Virginia; occupation, farmer. The family history does not appear to be of importance. Father living, suffers with rheumatism. Mother died of tuberculosis. One brother and one sister alive and well; four dead, causes not known. The patient has been married four years, and wife has not been pregnant.

The patient's past history shows that he has never had any serious illness except a fever four years ago, which confined him to bed for one month. He has suffered in the past with epistaxis, but this has occurred at no regular intervals, and he has not had any bleeding from the nose in the past year. No history of venereal disease, no urinary disturbances. He has considered himself quite well, and of normal sexual desires. He has always been aware of the fact that the scrotum did not contain the testicles, and for the last fifteen years he has noticed the presence of a small lump in the right inguinal region. On exertion, he found that the swelling increased in size, and would partially extend into the scrotum. When this occurred, he would be able to reduce it by lying on his back, elevating the leg, and using some force, which always caused considerable pain. Eight years ago, he was given a truss which he has worn since, and has been able to follow his occupation of farming. No swelling has ever appeared on the left side.

Physical examination showed an individual with a large frame, good muscular development, broad shoulders, narrow hips, and large hands and feet. Good growth of beard on lower face. Breasts not enlarged. The external genitalia appeared to be normal for an adult male, except that the scrotum contained neither testicle. The penis was natural in size, and the scrotum large and well formed. In the right inguinal region there was a mass about the size of a small hen's egg, which was distinctly tender on pressure. This could be readily defined by passing the finger into the inguinal canal, was firm and rounded, and descended on coughing. The left canal easily admitted two fingers, but no mass or hernial protrusion was noted. The clinical diagnosis was right inguinal hernia, undescended testicle.

Operation was performed October 30, 1907, under ether anæsthesia. The usual incision was made, and the inguinal canal exposed. A process of peritoneum was found in the canal and this was opened, disclosing a fibrous cord which was surrounded by a sheath containing a few enlarged veins, showing but slight varicosity. Gentle traction was made on this cord to see if the testicle could be brought down, with the idea of replacing it in the scrotum. As some little difficulty was encountered in this maneuver, firmer traction was made, which brought down the rounded body into the incision, but right after this came a fleshy mass, the nature of which was at first not understood. This mass was then drawn out into the incision, and we were very much astonished to find that it was followed by a globular body, and that on the opposite side of this there was a similar fleshy mass to that found on the right and another rounded body, like that present in the right inguinal canal.

As soon as these parts were assembled, it was readily seen that we had before us the fundus of a uterus with broad ligaments, Fallopian tubes, and two glandular bodies.

The body of the uterus was about the size of that found in an adult virgin. The Fallopian tubes were patulous, so as to admit the passage of a probe, and were perfectly formed, each having at its lateral end an infundibulum and fimbriated extremity. The two glands were oval and slightly flattened, corresponded in size and appearance to normal ovaries, showed some slight scarring, and each presented several small cyst-like elevations, resembling Graafian follicles on the surface of an adult ovary. There was no evidence of an excretory duct leading directly from either of these bodies, and neither of them showed any structure resembling or suggesting an epididymis. The finger

Sketch made at time of operation.

passed downward behind the uterus came in contact with a slight dilatation after the region of the cervix was reached, but as these manipulations were simply made through the enlarged internal ring, the exact detail of the structures deep in the pelvis could not be outlined. The accompanying illustration is from a pen-and-ink sketch made by Professor Henry Winston Harper, M. D., of Austin, Texas, who was present at the operation, and to whom I am much indebted for his accurate portrayal of conditions as seen at the time.

As there was no justification to mutilate this patient in any way, none of these organs was removed, so that I am unable to report on the histological structure of any of the tissues in question. Quite a number of gentlemen were present at the operation, and all were very much impressed by the exact similarity in appearance of these organs with those of the normal internal genitalia of a healthy woman. The operation simply consisted in replacing these singular structures in the abdomen, closing up the sac of peritoneum, and then repairing the inguinal canal. The patient's recovery was uneventful, there is now no evidence of hernia, and he is quite unaware that his pelvic organs differ in any respect from those of a well-formed man.

A case, very similar to this one, was reported by Dr. J. Clarence Webster at the meeting of the Chicago Gynecological Society, April 19, 1907 (SURGERY, GYNECOLOGY AND OBSTETRICS, Oct., 1907, p. 484). This case was as follows:

The patient was a farmer, about 34 years of age. He was admitted to the hospital with acute abdominal symptoms following the kick of a horse. There was a swelling in the scrotal region, and as he had always had what was considered a hernia there, it was supposed the kick had injured this hernia, and that it had become strangulated. An incision was made over the hernia, but instead of bowel or omentum, there was found what appeared to be a normal female uterus with ovaries and tubes, the uterus being attached to the prostate. Those parts were removed, and as there was general peritonitis, the belly was opened in the middle line, but as the patient was in such bad condition, practically moribund, nothing was done except to examine the pelvic cavity. The patient died shortly after leaving the table. The specimen consisted of the body of a uterus, similar to that one would get after a supravaginal amputation, there being a slight depression of the fundus. There was a Fallopian tube on each side, and two structures in the position of the ovaries and which resembled the latter, except that they were smoother; they looked like swollen ovaries. On both sides there was a round ligament and a broad ligament; on the left side the latter contained a cyst about three inches in diameter. On dissection, a vas deferens was found in each broad ligament, close to the uterus. It was small in its upper portion, but increased as it passed downward toward the cervix, where it measured 5 m.m. transversely. The two bodies which looked like ovaries were not ovaries at all, but testicles; one was up inside the ring, the other in the scrotum. It is impossible for a uterus to reach adult size in the human female without ovarian tissue being present, consequently, one can infer that, although no ovarian tissue was present in the specimen, it must have been present in the man; consequently, the case must have been one of true hermaphroditism, of which only a few cases are on record. A small mass was observed, resembling an ovary, when the abdomen was opened. It was not carefully examined, but there can scarcely be a doubt that it was an ovary. The testicles resemble those of an adult, but no spermatozoa were found. The man, in earlier years, was the father of twins, so there is no doubt that the testicles were active formerly, at least. There is nothing corresponding to a separate epididymis, but the rete testis opens into a series of convoluted tubules in the broad ligament, in a position corresponding to the organ of Rosenmüller in the female, and they communicate with these large tubes (vas deferens or permanent Wolffian ducts) which run down the sides of the uterus towards the cervix. The Fallopian tubes have the charac-

teristics of the female Fallopian tube, except that there is a less marked condition of fimbriation at the outer end. One of the fimbriæ passes towards the testicle, corresponding to the ovarian fimbria in the female.

False hermaphrodism is really not an extremely rare condition, although any single operator is not likely to meet with a case more than once or twice in his experience. In 1904, Neugebauer (*Zentralbl. für Gyn.*, No. 2, 1904) was able to collect 942 cases of this condition from the literature. These cases may be classified into: 1. Male pseudohermaphrodites (i. e., individuals with testicles), who show either the development of a uterus masculinus, often with broad ligaments and tubes, or else have some deformity of the external genitalia so that these organs approach the female type; 2. Female pseudohermaphrodites (i. e., individuals with ovaries), who show a persistence of the male sexual parts, either in the formation of a vas deferens, or in the approach of the external genitalia to the male type.

In a certain number of instances, true hermaphrodism has been claimed for an individual, or a specimen, but very few of these will bear scientific criticism, for the reason that careful histological examinations were not made. As examples of true hermaphrodism, several of the following cases have often been quoted: Heppner (*Archive für Anatomie, Physiologie, und wissenshaftliche Medicin*, p. 679, 1870) reported the case of a two month's old, premature infant with a rudimentary uterus and vagina, and on both sides a normal ovary, parovarium, and tube, and near each ovary was a body resembling a testis and containing tubules running toward the hilum. It is possible that these apparent testes may have been, in reality, supernumerary ovaries, with some abnormality of the parovarium or Wolffian body. Two somewhat similar cases are reported by Obolonsky (*Zeitschr. für Heilkunde*, vol. ix, p. 211, 1888) and Schmorl (*Arch. für path. Anatomie und Physiologie*, vol. cxiii, p. 229, 1888), but these are instances of lateral hermaphrodism, with an ovary or testis on one side, with an ovary and testis on the other. A still more recent example of a similar condition is recorded by Blacker and Lawrence (*Trans. of Obs. Soc.*, London, vol. xxxviii, p. 265, 1896). From these cases it would appear that the occurrence of what may be termed anatomic hermaphrodism in the human subject has been demonstrated.

A very remarkable case of supposed functional hermaphrodism was reported by C. W. Fitch (*N. Y. Med. Jour.*, Nov. 22, 1890). Mention of this peculiar patient, together with illustrations, appear in several of the recent text-books on gynæcology, and, stripped of inaccuracies, this is doubtless a remarkable example of feminine pseudohermaphrodism.

The legal aspects of hermaphrodism have always been much discussed. Many interesting questions may arise, and extraordinary complications naturally occur. There are cases of hermaphrodism in which the sex cannot be declared during life. Such cases are classed under the head of neuter hermaphrodism, and in the history of medicine not a few instances of this condition have been the cause of great disputes, with an array of medical and legal talent on each side, so that in some cases an individual has been given contradicting certificates as to sex.

The cause of malformation of the sexual organs, as of all other kinds of monstrosity, is still involved in mystery. We know that in the early part of uterogestation the sex of a fœtus cannot be distinguished, even when it has reached the fourth month.

Some organs, or parts, appear to be formed by equal and symmetrical portions, which gradually approximate and unite in the median line of the body. We observe this mode of union in the bones of the head, chest, and spine, as also in the various fissures, or raphes, of the skin. Defects in organization almost invariably occur in, or about, some part of the median line, and they appear to proceed from an arrest of growth or development of those particular parts, either on one side or both, during the early stage of uterine existence.

The development of the specific organs of one sex in the body of an individual possessing preponderating characteristics of the opposite gender, cannot be explained as readily as the instances of defective development. We can attribute such an occurrence only to the deposition of a curious *anlage* in fœtal construction.

# TORSION OF THE OMENTUM[1]

## Report of a Case

By Dr. W. W. GRANT, Denver, Colorado

The greater omentum in recent years begins to occupy a more conspicuous place in the eyes of the physiologist, the pathologist, the physician, and the surgeon. From its position as a protective blanket to the intestines, and aiding, perhaps, in their motility, it is believed to perform important blood functions, notably, by some authors, in the development of phagocytosis and opsonins. While Narath has utilized it, stitching it into the subcutaneous cellular tissue and improving the collateral circulation through the epigastric, internal, mammary, and azygos vessels, in cirrhosis of the liver, called a modification of Talma's operation. Besides its own pathology — the most important recent development and exposition being torsion — we find it performing a most useful function in various diseased conditions of associated organs. Surgeons are familiar with its conservative offices in enveloping a gangrenous appendix, a pus tube, gall-bladder, and ulcers of the hollow viscera, thus mechanically and by timely adhesions preventing immediate septic peritonitis and its dangerous consequences; and also giving valuable aid to the surgeon in the too frequent fortunate delays in dealing with these conditions.

On December 9, 1904, a young man (J. M. Duncan), aged 28, called at my office at 5 P. M., with the following history: Since noon suffering with pain in stomach and abdomen; occasional nausea, and had vomited once; slight distention, pain and tenderness on pressure in right hypogastrium; temperature 99, pulse 80; the tenderness covered a larger area, and was more marked, slightly to the inner side of the spot common to appendicitis; abdominal walls fat; patient weighing 200 pounds; no tumor palpable. Believing the history and the condition indicated appendicitis, I urged immediate operation, but was persuaded to wait till morning. Saw patient at 8 A. M., December 10th. He had slept none, on account of constant and severe abdominal pain all night — vomited once, distention increased, though still not great; tenderness in right hypogastrium much greater, and some dullness, but no distinct tumor, but difficult to make out on account of thick and fat abdominal walls; temperature 100, pulse 96. He was taken to St. Luke's Hospital and operated on (well within 24 hours from beginning of attack). With an oblique incision over cæcum and appendix, I introduced two fingers and immediately felt an unusual, rather elastic, lobulated, mass, which I perceived to be omentum. Not wishing to make a large opening, I soon succeeded, by gentle manipulation, in bringing the first or anterior omental mass, as large as the hand, out of the wound. All veins on the under surface were thrombosed and the mass excised. The succeeding, or under tumor, was now easily pulled out, and with it a coil of ileum, to which it was intimately adherent a few inches from the cæcum by a broad base, nearly an inch in length and fully half an inch thick. It was transfixed, ligated, and severed, and the peritoneal edges inverted and stitched over cut surface to prevent adhe-

Photograph of the specimen — at the lower end there were adhesions to the intestine.

[1] Read before the Western Surgical and Gynecological Association at St. Louis, Mo., December 31, 1907.

sions. The omental mass (as wide and as long as the hand) was very dark and gangrenous and completely separated from the body of the omentum, which, I assume, was due to a fourth twist, though there was but one distinct pedicle, which is beautifully shown in the specimen and photograph presented. The adherent intestine was perfectly healthy in every respect, with no constriction and no evidence of past disease, and there were no other adhesions to viscera, nor to abdominal wall, or hernial rings. About a quart of dark, bloody serum was mopped out of the pelvis. The appendix, only slightly congested, was also removed, and the wound closed without drainage. Recovery was prompt and uneventful.

I subsequently learned from his mother that, when two years old, he had a hernia of right side, for which Dr. J. D. Griffith, of Kansas City, applied a truss, which was worn for two years and resulted in a complete cure. Since that time no hernia has existed, and he has had no illness until the present, although he has had for a year or two an occasional indigestion, with vomiting.

In view of the most common association of this diseased condition with hernia, it becomes a matter of unusual interest in this case, as to its possible connection with hernia in earliest childhood. I am positive, from the nature and character of the adhesion, the condition of the intestine, and absence of any indication of disease, past or present, of every other organ or part, that it was of long standing. It seems possible that it could have dated from the existence of hernia in childhood, without causing intestinal obstruction or torsion at an earlier date. The vomiting may have been due to a momentary obstruction from volvulus due to the adhesion, and intestinal peristalsis.

The case reported is unique and interesting in two particulars: The fixed point being an adhesion without hernia to a coil of small intestine; and secondly, complete amputation by torsion of the diseased mass from the body of the greater omentum.

Undoubtedly, the motility of the intestine, to which it was firmly adherent, contributed largely, if not chiefly, to this result.

---

# INTRAABDOMINAL ROTATION OF THE GREAT OMENTUM, UNACCOMPANIED WITH HERNIA

## Report of a Case

By WILLIAM FULLER, M. D., Chicago

THE omentum majus, the great or gastrocolic omentum, was known to the earliest anatomists. Medical history tells us that the Egyptian priests, many centuries ago, prophesied by the omentum, and possessed regarding it mysterious notions or ideas, which they acquired in the process of embalming the dead.

Much of the knowledge possessed by the ancient anatomists regarding the omentum majus was incorrect, but time has not wholly controverted all that was recorded by them on this now well-recognized important structure. It is, therefore, to the later-day anatomists, embryologists, and to other investigators that we are so much indebted for a clear understanding of the structure, development, and functions of the great omentum, and its relation to other organs.

In elucidating the complicated and numerous evolutionary stages of the omentum majus, the embryologists have given an interesting and attractive description, greatly exceeding that of the anatomists. The embryologists have traced the great omentum from its most primitive state, the mesogaster, to its full development, which process is completed, according to Byron Robinson, in the second year after birth (man).

Of even greater or more practical importance than either the anatomy or embryology of the gastrocolic omentum, is its physiology and the rôle it plays under physiologic and pathologic conditions. One cannot review the work done in this connection without paying due credit to the work of Klein (1), of Muscatello (2), of Durham (3), of Dudgeon and Sargent (4), and to many surgeons who have, through

experimental and clinical observation, made valuable additions to the knowledge of the functions of the great omentum.

Dr. Byron Robinson has recently pointed out the fact that we are indebted for the earliest information of value concerning the omentum majus to the writings of Meckle (1714-1774) and of Mueller (1801-1858), of Malpigii (1638-1694) and of Haller (1708-1777). Following Haller's and Meckle's description of the omentum in the eighteenth century, nothing of importance was added to the literature of this subject till Toldt's (5) memoirs appeared in 1884.

The older writings on any subject are always of much historical interest, but for the purpose of amplifying our knowledge in a practical way regarding them, it is but natural we look to the investigations of writers of more recent times. In bringing together, therefore, a few facts in detail regarding the omentum, use has been made of the researches of Huntington (6), of Byron Robinson (7), of Eccles (8), and of Ross (9).

The literature on embryology of the great omentum contains a few conflicting opinions when reviewed in detail, but from a practical standpoint, or the viewpoint of the surgeon, they are not discrepancies of real importance. The functions of the omentum concern us as surgeons possibly more than all other features combined, and for having so clearly, so repeatedly, and so decisively emphasized the subject, no writer has done so well or so much as Byron Robinson.

The omentum majus may be the seat of origin of many pathologic conditions, both neoplastic and inflammatory; the new growths may be benign or malignant, and the inflammations are similar to those arising in other tissue and organs composed of like histologic elements; but the most curious and no doubt the least understood phenomonon exhibited by the great omentum is its disposition, under certain peculiar conditions or circumstances, to twist or rotate. For the purpose of studying this unusual and interesting condition, and to add a typical case of this kind to a somewhat meager collection, this paper is presented.

Without a working knowledge of the origin, structure, and function of an organ, the pathology of any disease to which that organ may give rise is never known, and therapeutic application under such conditions is purely guesswork; and for this reason a short description of the embryology, anatomy, and physiology of the great omentum is here given.

## EMBRYOLOGY

Owing to their inseparable relation, it will be convenient to consider the embryology of the gastrocolic omentum in connection with that of the stomach. The transitional stages of these organs, from the most primitive to the fully developed state, are so complicated, so interdependent, that one cannot be satisfactorily studied without the other.

Huntington has pointed out the fact that the primitive stomach, which is merely a dilated portion of the intestinal tube, is not at first an abdominal organ, but lies above the septum transversum, and finally reaches a sub-diaphragmatic position during the process of development. The primitive stomach with the intestinal tube divides the body cavity into two lateral halves, by passing vertically through the median plane of the body. The stomach is partially fixed in this position by a double layer of peritoneum, the mesogaster, which passes towards the future spinal column, and ultimately becomes the great omentum. This stage of development is fairly well shown, by referring to diagrams numbers 1 and 2, which represent the relationship about the second month of embryonic life, just previous to and after rotation of the stomach.

The process of stomach rotation from a vertical position in the embryo to that of a completely developed organ lying transversely in the abdomidal cavity is, as before stated, a complex transformation, effected by rotating in two directions. The first movement is rotation on a longitudinal axis, which places what was originally the right surface of the primitive stomach posteriorly, and the left surface anteriorly. The second action of rotation is designated by Heisler, the dorsoventral one, in which the pyloric end of the stomach migrates upward and to the right, occupying, when this movement is completed, almost a horizontal plane with the cardiac end of the stomach.

During the changes previously described the mesogaster is observed very early to present a pouching or bulging towards the left, presenting primitively a marked redundancy. This pouching of the mesogaster at first might be compared to a wide-mouthed bag, with its opening directed to the right side of the body, and the bag which is the omental bursa (diagram 3), or the future lesser peritoneal cavity, directed towards the left side of the body.

The mesogastrium continues its rapid growth unequaled, according to Byron Robinon, by any other organ in the body, increasing in all its dimensions, while the opening to the right of the sac-like formation of the peritoneum gradually diminishes in size, and ultimately becomes the foramen of Winslow.

The mesogastrium, which was at the beginning two

small slips of peritoneal leaves or blades occupying a vertical position, has now become a large transverse structure, composed of four layers of peritoneum suspended from the greater curvature of the stomach and transverse colon, and covering ,when unfolded, all the abdominal viscera except the liver and stomach (Heisler, Huntington, Gray).

The works further consulted in considering the embryology of the great omentum were those of Clelland (10), of Cruveilhier (11), of Lockwood (12), and of Eccles (13). The conclusions of Eccles differ with other writers regarding a few points concerning the first appearance of the omentum. His claim is, that before, and not after, stomach rotation, bulging of the mesogaster to the left may be noted, and that the portion of the mesogaster chiefly concerned in the formation of the great omentum is that part of it extending between the middle of the greater curvature of the stomach and the pylorus.

## ANATOMY

The gastrocolic omentum is a fold or reduplication of a double layer of the peritoneum, which hangs, when fully developed, in apron fashion, dorsal to the anterior abdominal wall, and separates the latter from the abdominal viscera.

The great omentum is usually the first structure encountered when the peritoneal cavity is opened; its dimensions are, when free from pathology and lying

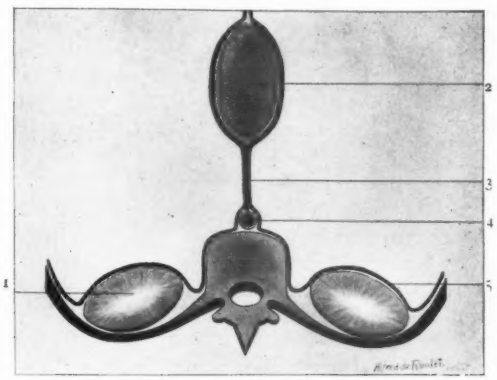
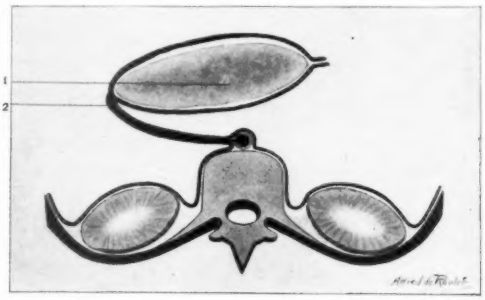



Fig. 1. Schematic representation of dorsal mesogastruim before rotation of stomach (after Huntington).
1. Kidney.
2. Stomach.
3. Dorsal Mesogastrium.
4. Aorta.
5. Primitive Parietal Peritoneum.




2. Schema of dorsal mesogastrium after rotation of stomach — early stage (after Huntington).
1. Stomach. 2. Mesogastrium.

in the normal state, sufficient to hide from view nearly all of the abdominal contents.

The gastrocolic omentum extends from the greater curvature of the stomach above, to the lower part of the abdomen below; it passes distally into the pelvis according to Byron Robinson in 25 per cent. of male and 50 per cent of female subjects. Lockwood observed in 50 per cent of cases examined under 45 years of age that the omentum could be brought down to the symphisis pubis, and in the cases over 45 years old, it was the rule, when pulled upon, to pass well below the limits of the abdomen.

The great omentum is made up of four distinct and separate layers of peritoneum, which may be demonstrated in the young subject, but which become so intimately coalesced in the adult subject that their separate or individual identification is no longer possible.

Between the ventral and dorsal layers of the omentum there is present a part of the lesser peritoneal cavity which communicates with the greater peritoneal cavity through the foramen of Winslow.

The great omentum is continuous on the left side with the gastrosplenic omentum, and its right border extends onto the right colon, and is here called the ligamentum colicum Hallerior, or "Haller's omentum" (Gray, Robinson).

In the new-born child the omentum majus occupies a somewhat left-sided position, and is relatively much shorter and smaller than in the adult. Its position on the left side has been explained by the following facts: First, it has its origin in a left-sided pouching of the mesogaster; secondly, intestinal peristalsis has a tendency to carry it to the left; and thirdly, the greater curvature of the stomach is directed towards the left side of the body.

The great omentum is found in all mammalia, and a striking and interesting fact is the strong resemblance between the mesogastrium of the human fœtus and that of the lower animals. This resemblance is due to the absence in the human fœtus of a coalescence between the omentum and the transverse colon; this coalescence being a post-natal development, the significance of

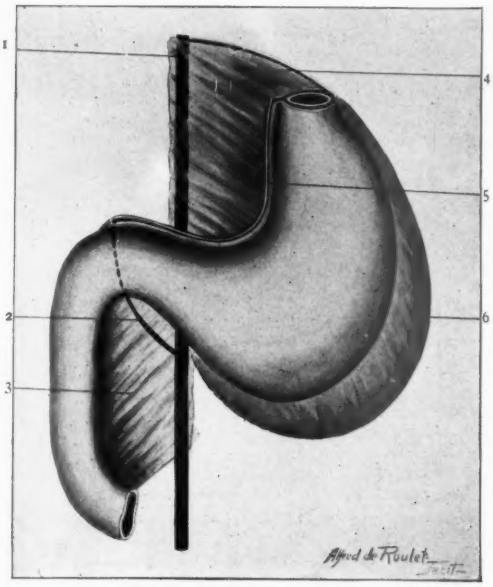



Fig. 3. (After Huntington.)
1. Aorta.
2. Hepatic Artery.
3. Mesoduodenum.
4. Dorsal Mesogastrium.
5. Ventral Mesogastrium divided along lesser curature.
6. Omental Bursa.

which remains as yet unexplained (Robinson, Hutchinson).

The mesogastrium possesses an abundant blood and lymphatic supply; its main arterial vessels are the right and left gastro-epiploic, which anastomose and run between the two descending layers of the omentum. The veins of the same name and practically the same distribution, with their small tributaries, are capable, under certain conditions, of great distension, and empty into the portal circulation (Gray, Morris).

The position of the great omentum and its relation to the surrounding organs are subject to extreme variations. In order to demonstrate this point, Eccles examined 90 subjects, and in only 50 per cent of them found the omentum unfolded and covering the underlying organs. Gordon E. Dickenson (14), in commenting upon this, says that (*a*) intestinal peristalsis, (*b*) the pumping action of the diaphragm, and (*c*) the ever-changing abdominal pressure, explain satisfactorily this peculiarity. Eccles suggests that the mode of the patient's death will oftentimes explain the post-mortem position of the omentum, and cites two strange cases or instances of this kind. One was an old man who died with an empyema, following rib fractures; the omentum after death was found free from adhesions or pathology, tucked away between the under surface of the diaphragm and the upper surface of the liver. In the second case the omentum, without appearance of disease of any kind, was found rolled into a large mass and lying in front of the duodenum. This omental mass readily unfolded and offered no explanation of this strange occurrence.

### FUNCTIONS OF THE OMENTUM.

The functions of the great omentum are so numerous and so important, that in a communication like this no more than the shortest reference can be made to but a few of the more important ones.

The experiments of E. de Renzi and Boeri (15) show the omentum to be an organ possessing great protective power. These investigations proved it possible for the omentum, after interrupting the splenic circulation, to completely circumscribe and encapsulate the spleen, and to remove within two and one-half months' time the entire organ. They further showed that, if the omentum is removed at the time of ligating the splenic vessels, encapsulation of the spleen does not occur, and death of the animal is the result. Of equal importance to these functions of the great omentum is the power it possesses, according to these and other observers, of neutralizing toxines, coming from various sources.

Tietze (16) divided the results of his investigation in the omentum into three groups, as follows:

1. Experiments in which pieces the size of a silver dollar were removed from the stomach wall, including all the coats, were accurately replaced and retained by sutures; many of the animals died from leakage and subsequent peritonitis.

2. Similar pieces, as in group 1, were removed from the stomach, and the openings were closed by several layers of omentum; tamponing with omental grafts, as the author expressed it, and in none of the cases did leakage occur.

3. These comprised experiments of end-to-end union for divided intestines; the ends were united by four sutures placed equidistant from one another, leaving thereby four large sections of the gut-ends ununited. These ununited portions were accurately held together by omental grafts, sutured all the way round the

circumference of the bowels. The healing was perfect and no deaths occurred.

Besides an organ of protective power, the functions of absorption and secretion are explained by a liberal blood and lymphatic supply. The power possessed by the great omentum in rapidly circumscribing and limiting all infectious lesions occurring in or reaching the peritoneal cavity, constitutes one of its most important functions, and is a fact which has been verified many times over in the performance of abdominal surgical work. The omentum possesses a wide range of motion, and, in the words of one writer, floats in the peritoneal cavity; but the manner by which it reaches and circumscribes harmful and diseased processes is explained by physical law, and not by an independent intelligence of the omentum, as has been ascribed to it.

The migrating tendency of the great omentum enables it to reach and effectively close in many instances otherwise dangerous communications between the peritoneal cavity and the lumen of the alimentary tract. Every surgeon can furnish many examples of this, but no instance demonstrates it so well as a recent case which was communicated to the writer since this paper was commenced. A man dead of peritonitis produced by an unsuccessful surgical attempt to close a perforated typhoid ulcer, presented at autopsy a second but overlooked ileal perforation, completely sealed and closed by a plug of omentum, which hung dependent about two inches within the lumen of the bowel.

The capacity of the great omentum to regulate currents within the peritoneal cavity led Tait to designate it the "arbiter of peritoneal tides," while its great mobility, and its tendency in the localization of peritoneal inflammatory conditions, led Byron Robinson to term it the "policeman of the belly."

It fulfills a useful service in the performance of plastic surgical work within the abdomen in covering denuded areas, defects in suture lines, and doing patchwork of all kinds within the peritoneal cavity. Experience has shown that omental grafts, severed or unsevered, serve equally well under some conditions.

The manner in which the experiments of E. de Renzi and Boeri showed how in a few hours the encapsulation of other structures could take place when deprived of their blood supply, is very much as the omentum circumscribes and removes from the general peritoneal cavity foreign bodies accidentally left in the abdomen. In the case of a sponge the omentum, as Byron Robinson has said, with an apparent preordained or physiologic intelligence circumscribes and maintains the sponge in coaptation to the intestinal surface. By the migration of pathogenic organisms through the intestinal wall the sponge becomes infected, leading to necrosis and perforation of the intestinal wall, through which the sponge passes. The intestinal opening is closed by the omentum, and the sponge finally escapes through the rectum, explaining the successful defecation of this and other foreign bodies accidentally overlooked during abdominal sections.

## TORSION OF THE OMENTUM

Practically all that is known regarding omental torsion is to be found in a contribution by Corner and Pinches (17) which appeared in 1905. Pretsch's (18) able paper on this subject was published in 1906, and the largest collection of cases of omental torsion is contained in a report by Lejars (19), which appeared in 1907.

Oberst, in 1882, reported the first case of omental torsion, which he found in an irreducible hernia. Demons described a similar case eleven years later. The greatest number of cases have been reported perhaps within the last ten years, and torsion of the omentum, especially the extraabdominal variety, is now quite well understood.

The paper by Corner and Pinches contained all the cases of omental torsion in the literature, and numbered 53 in all. The paper of Lejars added a few more, and brought the number up to 66. In the three contributions, however, cases of omental torsions of all kinds were included, and out of the collection of 53 cases by Corner and Pinches, only six of the intraabdominal variety were found, and only seven of this type in the collection of 66 cases by Lejars.

## CLASSIFICATION

The best classification of omental torsion is that by Corner and Pinches, which divides the subject into three classes:

1. *Abdominal.* Torsions of the omentum within the abdominal cavity, unaccompanied by hernia.

2. *Hernial.* Torsion within a hernial sac.

3. *Hernial and abdominal.* Torsion not limited to the hernial sac, but extending into the abdomen, or where there is a twist in both the hernia and abdomen.

The hernial and abdominal type greatly predominate in frequency, and constituted more than 60 per cent of the total number of cases collected by Corner and Pinches. Sixty-seven per cent of the total number were males, and in 80 per cent of the cases the ages were between 35 and 55.

The intraabdominal type of omental torsion, and the type only with which this paper is concerned, is rarely seen, and has never been correctly diagnosticated previous to operation. According to the reports from various sources, it is shown to constitute a little more than 10 per cent of the total number of all the cases.

Smythe (20) has recently reported a case which he regarded as belonging to this type, but the report states that the patient had a hernia, which on two occasions was difficult to reduce. Although the hernia was in the left side of the abdomen, and the twisted omental mass was in the right side, showing no connection at the operation, is not proof that there was no relation between them at some time previous to the operation. In view of the large number of cases of omental torsion which are accompanied with hernia, coupled with the belief of some that torsion of the omentum does not occur without hernia, justifies, I believe, the excluslon from the intraabdominal variety any case in which there is a hernia, although the operation discloses no direct relation between them.

The last case of intraabdominal omental torsion to be reported was a very typical one by Skeel (21), who, besides the six cases reported by Corner and Pinches, collected five more from the literature, making twelve in all.

It will be seen, however, on careful examination, that three of the cases reported by Skeel can be rightly rejected. The first of these is a case reported by Eitel (22), which can scarcely be regarded as a torsion, for, as stated by the author, it was a "rare omental tumor," and which he further said was "rolled upward and inward." In this case the omentum was not strangulated; there were no adhesions, no twisting, no dilated veins, no pedicle. The omentum in this case was unfolded, spread out over the viscera in a normal fashion, in which position it remained. Richardson (24) has well said that no case should be deemed a torsion which does not show by its twisting that some degree of strangulation is present. The second in Skeel's collection is Stewart's case, which, like Smythe's, had a hernia, and should for this reason also be excluded. The third case is one by Corner and Pinches, regarding which there can scarcely be any doubt, but which should not be included in this list of intraabdominal torsion, for, as stated by Skeel, it could not be verified.

The exclusion of the three cases just mentioned, makes Skeel's case the ninth, and my own the tenth case of intraabdominal rotation of the omentum without the presence of a hernia.

While it may be said that no reason thus far has been given why the presence of a hernia would or might preclude the possibility of an independent rotation of the great omentum, it may be said that the large per cent of omental torsions which are accompanied by hernia is very significant.

Riedel (23), as quoted by Richardson (24), believes that many of the "no hernia" reports are merely cases in which the hernia was overlooked, or which had undergone spontaneous cure. In operating on a case of omental torsion, Riedel believed there was no hernia present till a close and careful examination before releasing the omentum, showed it to be adherent in an unsuspected femoral hernial sac — the only case I have been able to find occurring in a femoral hernia.

In this connection reference may be made to Baldwin's (25) criticism of Wiener's (26) case, which was reported by the latter as an intraabdominal rotation. His patient had had a hernia for thirty years, but it was thought by Wiener to have no connection with the torsion, as the latter was high up. Baldwin rightly questions the conclusions thus drawn, and states that an omental, pedunculated tumor might have taken place years before

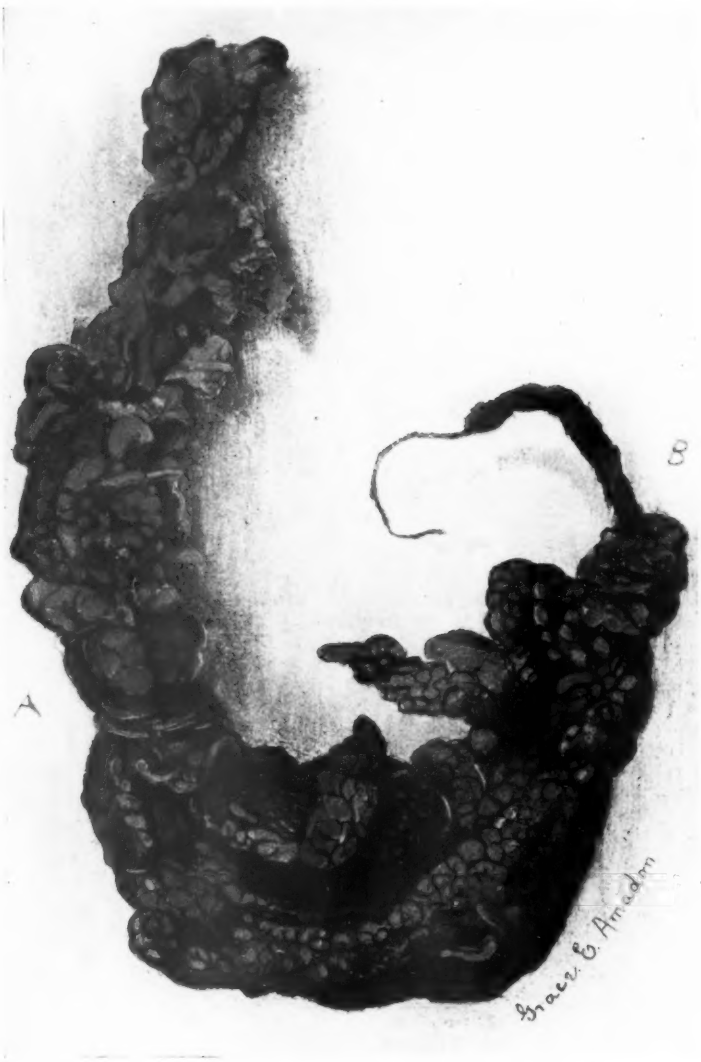



Fig. 4. Torsion of the entire great omentum. A, pedicle or point of constriction above the strangulated omental mass; B, greatly stretched adhesions twisted into a slender cord-like structure. Author's case.

from the entrance of the omentum into the hernial sac, and that conditions favorable to the twisting of the pedicle did not occur until late.

The cases of intraabdominal torsion without a hernia are as follows:

1. BALDWIN (Ann. Surg., Dec., 1902). Male, aged 47 years; previous good health. Omentum rolled into a mass and adherent to surrounding structures.

2. NOBLE (Amer. Jour. Obst., 1904). Female, aged 24 years. Had had abdominal pains for previous two years. Omentum was twisted into a long, dark mass, and attached to the right Fallopian tube.

3. SCUDDER (Ann. Sur., Dec., 1904). Male, 35 years of age. Had abdominal pains for seven days. Omentum was dark, twisted, and attached to the rectum and pelvic walls.

4. SYME (Inter. Coll. Med. Jour. of Australasia, 1902). Female, aged 27 years; previous good history, except a fall which the patient had received. Omentum twisted into a mass and adherent to the intestines.

5. SIMON (Münch. Med. Wochenschr., Oct. 10, 1905). Male, aged 26 years; always healthy. Case resembled appendicitis. Whole omentum was twisted on pedicle size of thumb close to the transverse colon.

6. CULLEN (Johns Hopkins Bulletin, Dec., 1905). Male, aged 47 years; good health previous to physical encounter with assailant, which was followed by abdominal distress and pain. Omentum was twisted, gangrenous, and adherent to gall-bladder.

7. RIEDEL (Münch. Med. Wochenschr., 1905, No. 41). Female, 38 years old, v para; always healthy; pregnant for the sixth time; premature delivery at the sixth month. Tumor could be felt through the vagina. Omentum was found twisted and adherent to bowels, uterus, and anterior abdominal wall.

8. RIEDEL (Münch. Med. Wochenschr., 1905, No. 41). Female, 38 years of age; was thought to have appendicitis. Omentum twisted and adherent to the surface of liver and the diaphragm.

9. SKEEL (Am. Jour. Obst., Dec., 1907). Male, aged 21 years; always well previous to operation. Attack began suddenly. Omentum twisted into a large, dark mass, with pedicle at transverse colon.

10. WM. FULLER. Woman, married; aged 38 years; was first seen by me, April 26, 1906. At that time she was suffering with abdominal pain. Her family history was unimportant, and she had always been well, with the exception of two or three attacks of abdominal pain during the previous year. These attacks were all similar in character, of short duration, lasting a day or two, and leaving her as well as before.

*Examination.* The patient was very large and fleshy, weighing 250 pounds. The abdomen was very prominent and contained much fat. All the important organs were healthy. The temperature was 100 F., and the pulse was about 90; the tongue was furred and the bowels had not been active for a day or two. She was nauseated, but had not vomited. The pain was distributed about over the abdomen and was colicky in character; the abdomen was tender everywhere, but was much more so on the right than on the left side. She was not jaundiced. The induration or resistance to the palpating hand was more apparent over the cœcal area. There was no dullness on percussion. No tumor could be felt through the abdomen or by vaginal or rectal examination. There was no hernia. Urine analysis was negative. A blood count was not made. The diagnosis of recurrent appendicitis was made and operation advised.

The patient returned to her home after a very uncomfortable ride of two or three miles, which she was sure intensified her pain. I saw her for the second time on the same day about 10 o'clock P. M. The pain was much increased, the abdomen more distended and more tender to touch. The temperature was 101 F., and the pulse was about 100. She had vomited several times, and her bowels had not moved.

The abdominal wall was very thick, and the incision necessary for the proper and easy performance of the operation was much longer than usual, and was placed at the outer border of the right rectus muscle. The peritoneal cavity contained several ounces of dark, bloody fluid, which escaped immediately after the peritoneum was opened. The small intestines were pushed aside, which brought into view a rotated, ropelike mass passing through the abdominal cavity from above downwards. This proved to be the great omentum, attached at both extremities and showing considerable tension. The lower attachment of the omental mass was at the fimbriated extremity of the right Fallopian tube and right broad ligament; the upper attachment was at the stomach and transverse colon. Between these two points the omentum, before releasing it from below, presented several rotations or twists, which appeared to be more uniformly distributed than the specimen now shows. When the adhesions were released from the tube and broad ligament, it recoiled into a somewhat shapeless mass, as it now presents, and showed two points of constriction or torsion. One of these points was at the attachment of the tube and broad ligament; the other was three or four inches below the transverse colon.

The omentum was cut away above the higher constriction, and after ligating it was replaced in the abdomen. The abdominal cavity was sponged free of all fluid, and the wound closed in layers by catgut sutures, except the skin, which was closed with silk-worm gut. The wound healed by primary union, and the patient left the hospital in 15 days.

### MICROSCOPIC REPORT

Microscopic sections were made from different localities in the torsioned tissue mass, and typical omental tissue was shown in them all. There is free blood to be seen in the meshes of the adipose tissue and adjacent to the blood-vessels. The blood-vessels are distended and contain coagulated blood.

### ETIOLOGY AND MECHANISM

The etiology of intraabdominal torsion of the great omentum is not definitely known. In studying the causes which appear to bear the closest relation, one must conclude or believe that the conditions which are responsible for this strange occurrence are numerous. It seems highly improbable, after reviewing the functions of the omentum, that it could be produced by any single factor.

Hernia is thought by many to be a potent element in the production of omental torsion, as it is found in such a large per cent of the cases.

Lejars regarded tumors of the omentum as a

condition predisposing to torsion. Richardson believes that matting of the omentum favors it. Omental torsion has been produced experimentally by Payr (Archiv für Klinische Chirurgie, 1902, band 68), by the formation of gas cysts in the omentum. This observer believes that the very distensible veins often becoming so much longer and more tortuous than the stiffer arteries around which the veins turn or rotate, may explain often the omental torsion. Such influence as vigorous exercise, continual coughing, trauma of various kinds, have all had their advocates. Simon makes positive claim for trauma as a cause of torsion in the case reported by him.

I am not convinced that any one factor thus far mentioned can produce omental rotation, but believe that a combination of definite changes in regular order must take place to account for this interesting phenomonon.

In an effort to demonstrate the truth of this question and reach a clearer understanding than now prevails, it will be necessary to begin as near the beginning as possible. Just as the examination of a normal extremity is indispensible in determining the condition of an injured one, or as pulmonary or cardiac diseases are easiest understood when the normal lungs and heart are known, so the facts of the question at issue should be sought by first reviewing the omentum with perfect structure and normal function. Given, then, an instance in which the normal omentum is free from pathology of whatever kind, torsion or rotation would probably never occur.

Bearing in mind the wide range of motion which is peculiar to the omentum under these circumstances, permitting it to occupy at longer or shorter intervals, all regions within the abdominal cavity, explains not only how life is protected by this feature, but how in this fixation or anchoring of the omentum, the first step or prerequisite in the internal torsion or rotation of the omentum is furnished (Fig. 1). The omentum becoming thus attached at some point along its crenated border, forms, according to the extent of the adhesions, a greater or lesser omental mass.

The influences which normally transport the omentum on its excursions through the abdominal cavity, and which are doubtless often exaggerated, by the same conditions which anchor the omentum, are now exerted on an organ no longer free to move in all directions and away from the slightest forces, but to one hampered and crippled, fixed at both ends, and often perhaps under great tension.

The result of prolonged and continued forces acting from within and from without on an omentum fixed in the manner described, the tendency to pedunculate or attenuate the omentum at one or more points between the attached extremities is very great, as shown by Fig. 5.

Thus is formed an omental mass suspended by a pedicle, with or without adhesions at the bottom of the tumor. The condition is now similar to the pedunculated ovarian tumor which suggested to Rokitansky the explanation of torsion in this kind of tumor, and may be offered as an explanation of what I have designated the second step in the intraabdominal torsion of the great omentum.

Rokitansky believed, as recently quoted by Baldwin, that a pedunculated tumor with adhesions at the bottom of the tumor, and whose pedicle occupies a perpendicular axis, offers of all tumors the least resistance to rotation. If this is true of the ovarian tumor, whose pedicle is usually shorter and which is composed of tissues much less wieldy and pliable than those produced by omental torsions, the second step, in the latter condition, calls for no further explanation.

The rotation of a pedunculated omental tumor, without adhesions at the bottom of the tumor, or with adhesions which have been released by the torsion, would have as a rule but one pedicle composed of omental tissue (Fig. 6), whereas the rotation of a similar tumor, with adhesions at the bottom, would present two pedicles, the proximal one composed of omentum and the distal one made up of the overstretched and elongated adhesions (Fig. 7). If forces are now applied to either tumor above described, it is plain that the direction of least resistance would be round an axis which corresponds to that of the pedicle. The ease with which this resistance is overcome is perhaps less under some circumstances than is offered to the normal omentum on its excursions through the abdominal cavity.

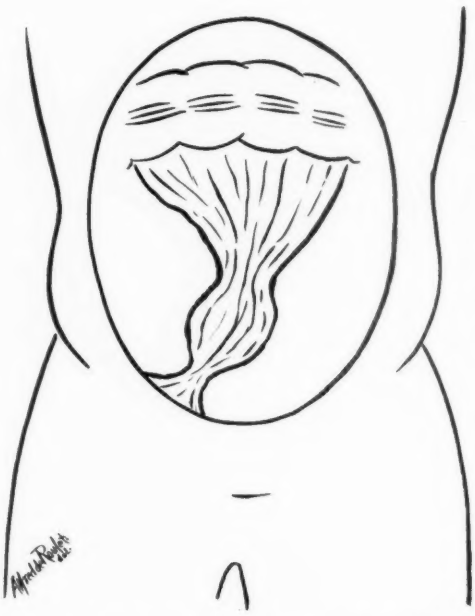


Fig. 5. Showing fixation of the omentum resulting in pedicle formation, or the first step in omental rotation.

A few revolutions of the omental tumor in the manner described, first impeding the circulation at the point of greatest constriction, finally interrupting the blood current entirely, ending with complete strangulation of the omental mass, completes the last step in the process of omental torsion.

As a short summary of the several steps in omental torsion as above outlined, a brief explanation of the probable etiology in my own case will be sufficient. It appears very likely that in this case at some previous time an infection from the Fallopian tube anchored the omentum, perhaps under considerable tension, thus providing the first step in the process of the torsion. The subsequent traction on the attached omentum produced a pedicle or narrowing of the omentum at the point of twisting now shown in the specimen, constituting another step in the torsion in this case. At the completion of this step, there was a pedunculated omental mass, with adhesions at the bottom of the tumor and the pedicle occupying a perpendicular axis in the abdomen, causing it, when subjected to the influences above described, to move in that direction, which torsioned the pedicle, obstructing the blood supply, and furnishing the third and last step of the omental torsion in this instance.

The stage of the process of omental torsion, in any case at which strangulation may be completed, will depend, first, upon the number of rotations in the tumor; secondly, on the diameter and size of the pedicle. That this process may be acute, sub-acute, or chronic seems possible, but that most cases belong to the chronic variety is probably correct.

It is intended that these surmises have nothing whatever to do, or are in any way applicable to the hernial torsions, as many writers, especially Hochenegg (27), have shown that taxis in reducing hernias is frequently wholly responsible for torsioned omental masses in hernial sacs. That taxis, as ordinarily used in reducing hernias, may prove alone the only factor in rotating the omentum within hernial

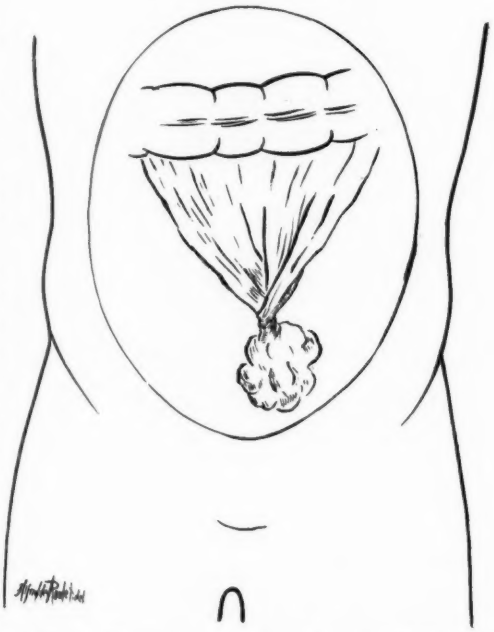


Fig. 6. Shows a rotated omental mass without adhesions at the bottom of the tumor, presenting but one constricted point.

sacs, is, I think, shown by Kruger (28) and Heinrich Mohr (29), whose recent reports have so well explained the intrahernial torsion of the appendices epiploicæ.

The cases of omental torsion reported by Broca (30) and Tuffier (31) can scarcely be, as regarded by Lejars, examples of rotations caused by inflammatory conditions and by tumors. It seems much more likely that the inflammation which was present in one of the cases was the sequel to, and not the cause of, the rotation. The tendency for the omentum to become adherent to adjacent structures when primarily inflamed is a fact which argues more for the prevention of its torsion than a factor in its production. Tumors, if large enough, would by their own weight likely attenuate the omentum at some point proximal to the tumor, and should be viewed in the light of a predisposing cause only.

The condition of intraabdominal omental torsion appears to be a form of omental adhesion or fixation, and is a feature which is recorded in eight of the ten cases here collected, while no reference to this point is made in the other two cases. It is likely that all rotated omental masses will present some kind of adhesions, but that there is a vast difference between adhesions occurring previous to and those occurring after omental torsion will scarcely admit of contradiction. Adhesions of the omentum developing previous to the torsion are of a very definite, dense variety, as presented in my own case, requiring some difficulty or effort to release or separate; whereas adhesions occurring subsequently to the torsion cover often a much greater area, but owing to an existence of short duration, are very delicate and friable, requiring little or no force to free or separate.

Rotated omental masses may present at operation no evidence of adhesions of the former variety, leading to the belief that torsions may occur without previous adhesions; while this is of course possible, it should be remembered that omental masses as found in intraabdominal rotations are small, and therefore do not, when non-adherent, explain the pedicle formation in the omentum, which is necessary always for a torsion.

If this hypothesis is a correct one, rotated

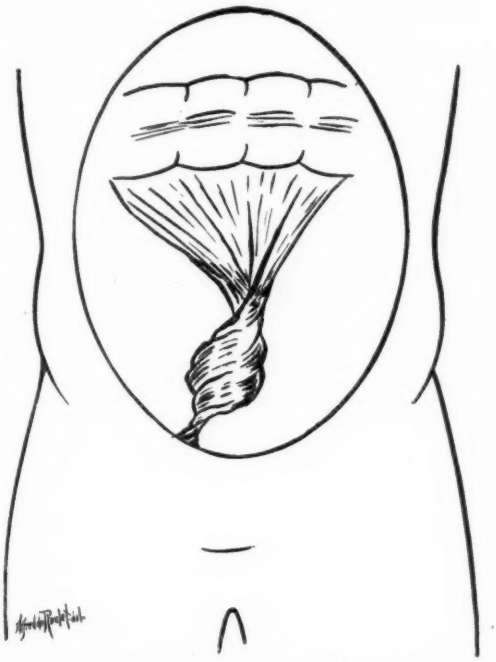


Fig. 7. Shows a torsion of an omental tumor with adhesions at the bottom of the tumor, representing two pedicles or constrictions.

omental masses exhibiting no evidence of primary adhesions or fixation very often have their explanation in the fact that the several revolutions of the omental tumor resulted in the complete disappearance or separation of such adhesions at some time previous to the operation.

For example, my own case presented adhesions of the primary variety, which were drawn out, as the specimen shows, into a long, attenuated, slender cord, in which torsion is plainly shown. It is not unreasonable or irrational to infer that a few more rotations of the omental mass, or a little more delay in the operation, might have detached this attenuated cord, showing at operation no evidence that it previously existed.

It is more than probable that the unequal length of the veins and arteries of the omentum, as advocated by Pretsch, Pyar, and others, is also a factor in its torsion.

The abdominal visceral vessels possess a

distinct spiral state, as is demonstrated by corrosion anatomy; and the spirality of the omental vessels, their irregular distension, and evacuation by blood strongly tend, no doubt to coiling or rolling the omentum. Hence visceral peristalsis, vascular spirality, and the contraction of cicatricial tissue, the result of omentitis, should be included among the etiologic factors of omental torsion.

### DIAGNOSIS AND TREATMENT.

In view of what has been said, it naturally follows that the diagnosis and treatment of intraabdominal omental torsions can be concluded in very few words. The symptoms have been correctly spoken of as presenting a fairly uniform clinical picture, and when the histories are studied and compared, this similarity is striking. Sutton has said that "the manifestations of axial rotation of abdominal tumors and viscera are similar to a strangulated hernia, minus stercoraceous vomiting." The symptoms and indications of an omental torsion are for the most part mild, and while exhibiting slight variations, perhaps, correspond also to the clinical appearances of many other and more common abdominal affections.

The rare occurrence of intraabdominal axial torsion of the great omentum, and the lack or absence of distinctive characteristics, warrant the assumption that its correct diagnosis previous to the operation is rarely possible. The truth of this subject was expressed in Corner and Pinches's able paper above quoted, when they said that the diagnosis at the operating-table, and not the differential diagnosis beforehand, is the point to be remembered.

I am convinced that this is the key to a better understanding of this part of the story of omental torsion, and when viewed impartially, will lead to more frequent reports of this condition than has been the rule. Corner and Pinches failed to add, that in trying to establish the diagnosis at the operating-table, there is need of bearing in mind, among other conditions, the possible existence of a torsion in a part or all of the omentum, occupying possibly some unusual or remote region of the abdominal cavity. The recognition of omental torsion during the performance of any abdominal operation would be likely, although such a condition had never entered the mind of the operator, provided the incision is so located as to expose to view the tumor; but when the incision has not been so located, it would not be at all remarkable or strange for a torsioned omental tumor to escape detection.

In the removal of the vermiform appendix, Fallopian tube, the drainage of the gall-bladder, or the obliteration of a hernial sac, it is rational for the operator sometimes to conclude that the indications have been fully met; but clinical histories and outward appearance of many diseases are very often misleading in the hands even of experienced surgeons, and considering the small collection to date of intraabdominal torsions of the omentum, its close resemblance clinically to diseases frequently occurring in the abdomen, leaves reason for suspicion that the infrequency of reports of omental torsion is not due entirely to the rarity of its occurrence.

In the light of present-day means and methods of diagnosis and treatment, such a contingency as the one above mentioned seems improbable; but the truth of the matter is shown by the mistakes that were made in the cases of which we now have a record. There was not a correct preoperative diagnosis in a single case of intraabdominal torsion, nor but one or two correct diagnoses in the sixty odd cases belonging to other types of torsion. The real nature of many of the cases was discovered by the merest accident; cases in which the omental tumors came into view after some other fancied or real pathologic condition offered sufficient explanation for the case in question.

The literature, besides reports of thes kind, contains the accounts of cases in which the omental tumors were found and removed, but the patients were lost because a second, unsuspected, or adjacent torsion in the omentum was not discovered.

Since operating on the case above reported, it has occurred to me that a mistake might have been made in this instance very similar to many previous ones in axial rotation of the omentum. The patient was, as the history stated, large and very fat. The diagnosis was recurrent appendicitis. The operation was performed after midnight, without a surplus of help. The anæsthetic was badly borne, and

the intraabdominal pressure was very great. Had this omental rope been attached to any other part of the abdomen than the right side, some very mild pathologic condition, like a moderately diseased appendix, might have explained satisfactorily the clinical history, leading to results in this instance more comforting to imagine than to realize.

In conclusion I would add:

1. That the omentum majus should be regarded by the surgeon as an organ of vast importance, and that its uses cannot be with safety curtailed or compromised.

2. That in all surgical operations requiring resection of the great omentum, the latter should be done in a careful manner, without leaving heavy or clumsy omental stumps uncovered by peritoneum, and that the omentum at the completion of all operations should be unfolded and spread over the abdominal organs in a normal manner.

3. That the condition in any operation within the peritoneal cavity, presenting the slightest doubt as to the causes and nature of the extent of the difficulty, search for a complete and satisfactory explanation of the question in hand should include, among other conditions, that of the greater or gastrocolic omentum.

## BIBLIOGROPHY


1. KLEIN. Anat. of the Lymphatic System, 1873.
2. MUSCATELLO. Quoted by Dudgeon and Sargent. Bact. of Peritonitis, 1905.
3. DURHAM. Med. Chir. Trans., London, lxxx.
4. DUDGEON AND SARGENT. Bact. of Peritonitis, 1905.
5. TOLDT. Prag. Med. Woch., iv, 121 and Deutscher Akad. Wiss., Wien, xli, 2 Abth. 1–56, 1884.
6. HUNTINGTON. Anat. of the Peritoneum and Abdomen, 1903.
7. BYRON ROBINSON. Amer. Med. Compend., 1904.
8. ECCLES. St. Bartholomews Hosp. Reports, vol. xxx, 1894.
9. ROSS. Am. Jour. Obstr. and Dis. of Women, 1893.
10. CLELLAND. Jour. Anat. and Physiology 1869, vol. iv, p. 198.
11. CRUVEILHIER. Anat. Descriptive, 4 e. edit., p. 537.
12. LOCKWOOD. Jour. Anat. and Physiology, 1884, p. 257.
13. ECCLES. St. Bartholomews Hosp. Reports, vol. xxx, 1894.
14. DICKENSON. Ann. Surgery, Nov., 1906.
15. E. DE RENZI AND BOERI. Berlin Klin. Woch., 1903.
16. TIETZE. Beitrage zur Klin. Chir., 1899, p. 441.
17. CORNER AND PINCHES. Am. Jour. Med. Sciences, 1905, cxxx, 314.
18. PRETSCH. Beitrage zur Klin. Chir., vol. lxxxiv, 1906, p. 118.
19. LEJARS. La Semaine Médicale, Feb. 13, 1907.
20. SMYTHE. Surg. Gyn. and Obst., Oct., 1906.
21. SKEEL. Am. Jour. Obst., Dec., 1907.
22. EITEL. N. Y. Med. Record, May 20, 1899.
23. RIEDEL. Zentralblatt f. Chir., 1906, vii, p. 184.
24. RICHARDSON. J. A. M. A., May 11, 1907.
25. BALDWIN. Ann. Surgery, 1902.
26. WIENER. Ann. Surgery, vol., xxxii, 1900.
27. HOCHENEGG. Wien. Klin. Wochen., 1900.
28. KRUEGER. Munch. Med. Wochenschr., Sept. 10, 1907.
29. HEINR. MOHR. Munch. Med. Wochenschr., 1907, No. 4.
30. BROCA. Rev. mens de mal de l'enfouce, Dec., 1902.
31. TUFFIER. Bull. et med. de Pa. Soc. Chir., Paris, meeting, March 4, 1906.


---

# SOME OBSERVATIONS ON PLEURAL REFLEXES

BY J. A. CAPPS, M. D., AND D. D. LEWIS, M. D.

SCATTERED throughout the literature are numerous instances of sudden death during aspiration of a serous pleurisy, or the drainage of an empyema, the cause of which cannot be explained by post-mortem findings.

Leichtenstern, in 1879, collected a number of these cases. He classified the sudden deaths occurring during aspiration into three groups: 1. Those due to pulmonary embolism; 2. Those due to cerebral embolism; and 3. Those cases which could not be satisfactorily explained by any anatomical findings.

Some illustrative examples of the last form of sudden death might be cited. Legroux reports the following case: A patient, 52 years of age, with a left-sided empyema, was aspirated. The heart was not markedly displaced.

Dyspnœa and some cardiac insufficiency were the indications for aspiration. Two liters of fluid were removed. The lung became distended and the heart returned to its normal position. Three-quarters of an hour later, the patient suddenly cried out and died. Post-mortem findings revealed no cause of death. It has been suggested in these cases that, if the pleural fluid is quickly evacuated and the lung cannot distend, there is a marked flow of blood to the pleural vessels and anæmia of the brain.

Death may occur, when there are no demonstrable changes in the viscera, and may be immediately preceded by convulsions, like those observed in acute cardiac failure and in cerebral anæmia.

Some of these deaths have occurred during irrigation of the chest, and correspond closely to those following opening of the chest cavity.

Koenig, in discussing the prognosis of typical operations for empyema, states that a number of cases of sudden death have been observed. Sometimes, syncope with sudden cessation of cardiac and respiratory functions, complete the clinical picture; while in other cases, the patient dies in an epileptiform seizure, in the so-called pneumoepilepsy. These cases have occurred most often after irrigation. He also states that rabbits die after an average amount of carbolic acid solution has been poured into a pleural cavity.

During the past year, two noteworthy papers upon lung surgery have been published by Körte and Lenhartz. The operations performed by Körte were performed without recourse to a Sauerbach chamber, or to Brauer's positive pressure apparatus. Körte reports 57 cases operated upon for empyemas, lung abscesses and gangrene, and suppurating bronchiectatic cavities. Three cases were suddenly seized with respiratory disturbances and collapse, after the operation had apparently been successfully completed.

These three cases are so significant that their case histories will be noted.

1. Male patient, physically considerably reduced by many hæmorrhages. He was operated upon under morphine and eucain anæsthesia, and a large cavity in the left lung was opened, the adherent pleural surfaces preventing the development of a pneumothorax. The patient stood the operation well, without suffering much pain. The hæmorrhage was insignificant. The pulse was good, and the operation passed off very smoothly. During the application of the bandage, the trunk being somewhat elevated, the respiration became short and spasmodic, the pulse poor, finally stopping altogether. The post-mortem examination, performed by Benda, revealed no cause of death.

2. In another patient, disturbances in breathing occurred during a second operation. Similar phenomena had been noted during a similar operation performed about three months before. The operation was performed under morphine and eucain infiltration anæsthesia; a little chloroform was administered near the end of the operation, but the strong, young patient was not unconscious and reacted when spoken to and coughed. While the lung fistula was being divided after transfixation, the respirations suddenly ceased; finally, the heart stopped beating and the patient died. Post-mortem examinations, conducted by Benda, revealed numerous bronchiectatic cavities in the left lower lobe, but no cause for sudden death.

3. A 52-year-old male patient, emaciated; the sixth and seventh ribs on the right side were resected. The pleural leaves were adherent, and the bronchiectatic cavities were opened without any pneumothorax.

Immediately after the patient was placed in bed, the respirations ceased, and finally the pulse. Artificial respiration was resorted to, a tracheotomy performed, the lungs inflated, venesection performed, and transfusion of salt solution given. Respiration returned, but the patient died three hours later.

Körte says, in conclusion, that I can explain these three sudden deaths only on the basis of a reflex arising from irritation of the vagus nerve. I cannot regard them as anæsthesia deaths. The second patient referred to had suffered collapse during an operation performed three months before under an anæsthetic mixture. These experiences show that pneumotomy, even in uncomplicated cases, is a procedure which is attended by danger. In Körte and Lenhartz's statistics, which comprise over 160 cases, some form of collapse occurred in about 10 per cent of the cases.

Convulsive movements, accompanying irrigation of the pleura, have been described by Auberue. They are sometimes followed by syncope and death; in other cases the patients recover, after a short interval, without any bad consequences. The convulsive movements are said to be more pronounced on the side corresponding to the diseased pleura. Milder cases, in which the convulsions are restrictedto one-half of the body, usually the affected, have been described by Weill as *pleuritic hemichorea*.

Brodie and Russell, in working upon cardiac

inhibition, have come to some very important conclusions concerning the relation of the terminal vagal fibers to the respiratory and vasomotor centers. The intimate relation between these centers and the fibers of the vagus is shown by the varying rate of heart-beat, observed in some animals during inspiration and expiration. During expiration, the rate of the heart is slower — a difference at once abolished by cutting the vagi in the neck. The difference in rate is usually well marked in dogs, but is not, as a rule, to be observed in man, the cat, and rabbit. Einbrodt was one of the first to attempt to determine the cause of this modification.

He found that, if an animal were made to respire air under a positive pressure, the heart was slowed. Hering showed that the results obtained by Einbrodt were somewhat misleading, as he had used excessive pressure. Hering seems to have proven pretty conclusively that this change is not due to any alteration in the mechanical conditions of the circulation affecting the heart or vessels, nor to any alteration in the gaseous respiratory changes. The acceleration during inspiration is due to an alteration of the tone of the cardio-inhibitory center, and the afferent fibers which are excited are in the lungs.

Brodie and Russell confirm the results obtained by Hering. They found that, when a fairly high pressure is used for respired air, the rate of the heart-beat may fall to one-half its former pace, but there is never any marked slowing which follows excitation of the central end of one of the pulmonary nerves. They have also shown that, during the whole time that artificial respiration is being carried out, the heart is constantly inhibited as a result of the inflation.

This phenomenon is more particularly marked in animals in which the thorax is open, and in which the total volume changes are consequently exaggerated. They also have found that changing the pressure of respired air from atmospheric to positive or negative pressure, causes a fall in blood-pressure, which is approximately proportional to the changes in air-pressure.

The following conclusions may be drawn from Brodie and Russell's work:

1. Of the branches of the vagus, excitation of the central end of which causes reflex inhibition of the heart, the pulmonary fibers are those which produce the most marked reaction. The cardiac fibers are much less effective and the branches below the pulmonary are still less effective.

2. The connection of the respiratory tract with the cardio-inhibitory center is very close. Thus, stimulation of the nasal mucous membrane at once arrests the heart. Stimulation of the laryngeal mucous membrane is only a little less effective. Stimulation of the trachea and large bronchi is apparently without effect, but stimulation of the alveolar nerves is about as effective as that of the largyngeal.

3. These nerves produce the result when excited electrically in their course from the mucous membrane, or when stimulated mechanically, or chemically, in the mucous membrane itself.

4. In addition to the effect upon the cardiac center, excitation of the pulmonary fibers also acts upon the respiratory and vasomotor, producing an arrest of respiration and fall in blood-pressure.

5. The alveolar nerves can be excited chemically by the inhalation through a tracheal tube of irritant vapors, such as chloroform, hydrochloric acid, ammonia, formaldehyde, or bromine.

6. Division of the pulmonary nerves on one or both sides completely abolishes the effect upon cardiac, respiratory, and vosomotor centers.

After sixty experiments upon animals with normal and inflamed pleura, we have come to the following conclusions concerning the cause of these sudden deaths which are not accounted for by post-mortem findings:

1. Aspiration of oil from the pleural cavity of healthy dogs causes little or no change in arterial pressure.

2. Aspiration of an inflammatory exudate from the pleural cavity often causes a more marked fall in blood-pressure. This fall in pressure depends more on the degree of trauma, or irritation, of the inflamed pleura than on the amount of exudate withdrawn, or the rate of withdrawal.

3. Irritation of the visceral pleura of healthy

dogs by mechanical, thermal, and electrical means, and by certain chemicals, produces little or no effect on the blood-pressure, except over the roots of the lungs, where mechanical and electrical stimulation produces long strokes of the vagal type.

4. The effects of irritation of the parietal pleura need further investigation. The common drop of blood-pressure and disturbance of respiration when a trocar is forced through the chest wall into the cavity, is probably due to injury of the parietal pleura. The reflex is usually transitory and is seen both in normal animals and in those with pleurisy.

5. In dogs with pleurisy, induced by turpentine or by oil contaminated with bacteria, excitation of the inflamed visceral pleura by mechanical and chemical irritants gives varying results. In some cases there is a marked fall of pressure; in others there is a considerable fall in pressure that may even be fatal.

6. These reflexes conform to two types, which as a rule, occur singly, but may be combined: *a*. The cardio-inhibitory type, in which the heart is slowed and the pulse tracings make violent excursions, with a great range between systolic and diastolic pressure. Respirations, also, are usually slowed and may be inhibited. This type of reflex when it occurs is seldom fatal. *b*. The vasomotor type, in which the pulse tracings show a steady rapid decline of pressure, without a great difference in systolic and diastolic pressure, and frequently terminates in death. Respirations, as a rule, are shallow, and may be rapid. In fatal cases the blood-vessels of the abdominal viscera are much enlarged from acute vasodilatation. The brain shows no evidence of embolism or hæmorrhage.

7. The cardio-inhibitory reflex is central, because it is prevented or stopped by cutting both vagus nerves in the neck. Atropine, in a dosage of 1 milligram, paralyses the cardio-inhibitory fibers and destroys the reflex.

8. The vasomotor (dilator) reflex may be central or peripheral. If central, the afferent impulses reach the medulla by way of the thoracic sympathetic, the white rami, and the cord, and not by the vagosympathetic cord. This is proved by the failure of section of the vagosympathetic cord to alter or abolish the reflex. If peripheral, the reflex goes from the pulmonary fibers to the pulmonary plexus, thence to the thoracic sympathetic nerves and downward through the splanchnics to the celiac and other plexuses in the abdomen. This reflex is more direct than the central form, but seems to us inconsistent with the views generally accepted as to the course and direction of impulses in the sympathetic nerves. Adrenalin is the physiological antagonist to the vasodilator reflex and is often life-saving. Atropine, on the other hand, by its tendency to dilate the cutaneous vessels and lower the mean arterial pressure, seems to intensify the reflex.

There is some evidence that the previous administration of atropine modifies the blood-pressure-elevating action of adrenalin and thereby deprives it of its full beneficial effect.

9. These types of reflexes occur, also, in man during operative procedures upon the inflamed pleura. The cardio-inhibitory type is manifested by a slow, intermittent pulse, with a great difference between systolic and diastolic pressures; the vasomotor type by a steady fall in blood-pressure, without a marked difference in systolic and diastolic pressures, and by a pulse that grows steadily weaker until it cannot be felt.

10. For emergency use in case of falling blood-pressure and symptoms of collapse, adrenalin intravenously is indicated. Atropine is of little service, and may even do harm.

11. Preventive measures come readily to mind. The instrument used in thoracentesis should not irritate the visceral pleura any more than is absolutely necessary. Therefore, the trocar is preferable to the needle. The trocar should not be inserted at a greater depth than is necessary to obtain fluid. Great care should be employed during the drainage of an empyema, especially to avoid a long projection of the drainage tube inside the cavity. Swabbing the pleural surface is attended with danger. Finally, we would emphasize the clinical importance of taking blood-pressure readings at the beginning of and during all operations in the pleural cavity, in order to foresee, and thereby prevent, the developments of a dangerous blood-pressure-lowering reflex.

# DEPARTMENT OF TECHNIQUE

## ADVANTAGE OF THE ELASTIC LIGATURE IN THE TREATMENT OF CERTAIN CASES OF ANAL FISTULA

By CHESTER M. ECHOLS, M. D., Milwaukee, Wisconsin

The ideal procedure for obliterating an anal fistula consists in dissecting out the fistulous tract and closing the incision at once with a view to securing primary healing and perfect restoration of the sphincter. This looks well on paper, but in practice it is rarely feasible. The more mutilating operation of slitting open the fistula and cutting through the sphincter by means of a knife or cautery is the one usually resorted to. This classic method, although widely used, has many serious faults. It insures the patient a slow convalescence with a gaping, dirty wound in the anus, a divided and retracted sphincter whose function is sometimes permanently impaired, and a considerable period of disability. Moreover, it requires general anæsthesia.

Several unsatisfactory experiences with the usual sphincter-cutting operation have led me to make use of the elastic ligature instead of the knife in selected cases. The idea of using an elastic band to cut gradually through the tissues between the fistula and the anus is by no means new — indeed it is so old that it is almost forgotten, and most works on general surgery do not mention it at all. I am convinced, however, that the elastic ligature method, properly employed, is the operation of choice, especially from the patient's point of view, in a much larger proportion of cases than has hitherto been supposed. It may be used without a general anæsthetic. When general anæsthesia is used I proceed as follows:

After inserting a probe through the entire length of the fistulous tract, the outer (cutaneous) opening is enlarged toward the anus and also, if necessary, parallel to the anal margin. The tract is now cauterized with a thermocautery, the sphincter meanwhile not being divided. Then a small-sized McGraw elastic ligature is inserted in the manner indicated in Fig. 2 and tied with moderate tension only, the object being to have the ligature cut gradually through the tissues indicated by the shaded area in Fig. 1. The cauterized fistulous tract is packed with a slender strip of iodoform gauze. After the first day or two the fistulous opening is treated daily with an application of balsam of Peru until healing is complete. Now, the elastic ligature gradually cuts its way through the sphincter, thus receding farther and farther away from the original fitsulous tract, which heals from the bottom *toward the bowel*. The ligature does not cut completely

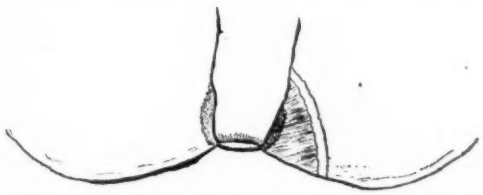


Fig. 1. Shaded area between fistula and rectum indicates tissues to be cut through by ligature.

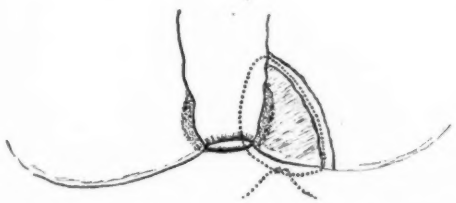


Fig. 2. Dotted line indicates position of elastic ligature inserted and ready for tying.

through the tissues it encloses, but there is finally left a narrow bridge of skin and mucosa which preserves the normal contour of the anus and prevents the wide gaping of the wound while the fistula is healing. When the ligature is removed this narrow bridge may be cut through under local anæsthesia, which procedure is, however, not usually necessary. The patient can sit up the day after operation, and though he may have some discomfort the first few days, the pain and disability are much less than after the more radical rectal operations.

One advantage of this method is its adaptability for cases where it desirable to use only local anæsthesia or none at all. Many patients carry about an anal fistula for years through the dread of a knife, a hot iron, or a general anæsthetic. Wherever it is possible to insinuate a probe through the fistula from skin to bowel, a small elastic ligature may be threaded through and tied gently with very little discomfort to the patient. After tying, the ends of the ligature—left four or five inches long—should be drawn aside and fastened to the buttocks by means of an adhesive strip. This facilitates removing or tightening the ligature later. Every few days the ligature should either be slightly tightened or a new one inserted. Meanwhile the fistulous tract is treated daily with balsam of Peru, and the patient can be up and about. Thus the fistula is transferred nearer and nearer the anus until coalescence occurs.

No claim is made that this operation is applicable to all cases, for example, the horseshoe-shaped fistula encircling the bowel. But for the ordinary complete fistula I consider it in most cases the operation of choice, because:

1. It preserves the contour of the anus and does not impair the function of the sphincter;

2. It is suitable for patients who cannot or will not take a general anæsthetic;

3. The period of complete disability of the patient after operation is less.

---

# A CASE OF CONCEALED HÆMORRHAGE IN PREGNANCY, CONTRASTED WITH ONE OF EXTRAUTERINE PREGNANCY

By GEORGE ERETY SHOEMAKER, M. D.
Gynecologist to the Presbyterian Hospital; Consulting Surgeon to the Womans Hospital, Philadelphia

IT so happened that at the same time two patients were placed by their physicians under my care with such an interesting similarity of symptoms that a brief account of them is worth while. Both were in the early months of pregnancy, both suffered from sudden severe pain, anæmia, and shock, without external hæmorrhage; and both recovered after different treatment, one requiring abdominal section and the other delivery through the natural outlet.

The patient presenting the rare condition of concealed uterine hæmorrhage was seen at the request of Dr. Charles A. Service, who had been called at four A. M. to see a young primipara of 23 who was six months pregnant. She had previously considered herself well, though the history showed a slight, irregular flow during the first month of pregnancy, which had entirely disappeared for five months, while for two weeks before the attack there had been some swelling of the hands and feet with shortness of breath, dimness of vision, and sleepiness due to nephritis. There had been little nausea; vomiting of pregnancy had occurred but twice. Awakened from sleep by violent pain in the abdomen and loins, worst on the right, she had perspired freely, almost fainted, and had vomited several times. Seen within an hour by Dr. Service, she had shown marked pallor with scant external bleeding, and a sudden enlargement of the abdomen, the pulse being 144 and weak. Eight hours later when seen by myself, only partial reaction had occurred. The lips were blue and the surface pale; pulse 128; vaginal and breast signs of pregnancy; abdomen prominent from a symmetrical rounded mass, very firm, reaching three and a half inches above the navel. Constant pain in lower abdomen and loins; no labor pains, no fœtal heart sounds. There had been no vaginal hæmorrhage but a scant discharge like a menstruation. The os was closed. The patient stated that prior to the attack the abdomen had been quite small, but the projection forward and the general size and appearance resembled a pregnancy near term. A blood examination made later showed hæmoglobin 60 per cent in a woman previously of good color. Examination failed to show signs of clot in the pelvis or abdominal cavity. The definition of the enlargement, apparently uterine, formed practically the only point which distinguished the condition from one extrauterine pregnancy with rupture.

Under the diagnosis of concealed intrauterine hæmorrhage the patient was admitted to the private maternity department of the Presbyterian hospital, and delivery slowly accomplished twelve hours later by the use of dilating bags, small doses of ergot, and finally low forceps. There were no labor pains at any time, the thin uterine wall tightly grasping the mass of clot, unruptured amniotic sac, and contents. A slight, serous, blood-stained discharge was maintained, probably squeezed from the clot above the amnion. Membranes artifi-

cially ruptured late. A six months child, dead and slightly macerated, was delivered L.O.A. without any bleeding, after which 23 ounces by weight of firm black clot was expressed, followed by the placenta and membranes with no fresh bleeding. Because of uterine inertia, a gauze pack was used as a protection. Convalescence aseptic, a few small clots requiring expression from the poorly contracting uterus later. Nephritis was severe, requiring dry cups, retained colon enemas, etc. Retinal hæmorrhages about the ninth day almost destroyed vision in the left eye, and an active albumenuric retinitis was present on both sides. This, under the advice of Dr. Thorington, gradually improved and the patient is now going about her home.

Small infarcts are found in all placentas later than the seventh month and are now considered physiological. Before the seventh month, however, they are usually the result of syphilis or nephritis and if large may interfere with the nutrition of the fœtus or cause its death. Large hæmorrhages or true apoplexies of the placenta are rare. They may occur either in the maternal or fœtal portions and are usually caused by inflammatory or degenerative changes. In this case, the maternal surface showed many pale firmer areas half an inch in diameter. Microscopical report of the hospital laboratory: Amyloid degeneration. A mass hæmorrhage had apparently lacerated the placenta, so that after expulsion the maternal surface showed a large, cup-shaped cavity.

The condition of acute intrauterine hæmorrhagic with shock is a rare one, and is quite different from the common one of placenta prævia with the early escape of blood and the later plugging of the cervix by the head. Here the placenta was placed high. Nephritis caused degeneration of its structure, and of its vessels as well as those of the retina, as shown by the hæmorrhage there. Escaping blood tore off the central portion and distended the fundus above the child and sac, producing shock.

One of the chief points of interest lies in the differential diagnosis. There was little except the shape and rigid distention of the uterus which formed a contrast with ruptured extrauterine pregnancy. In the latter the blood masses and sac lack firmness and distinctness of outline immediately after rupture, though later the blood incarcerated by an inflammatory adhesion-sac forms a mass not so easily distinguished from an adherent pregnant uterus, and, on at least three occasions, I have known the mistake to be made.

The other patient presented the more usual history of ruptured extrauterine pregnancy, plus abdominal distension from gas. Age 37, births 5, miscarriages several. No periods had been missed; but the last, a month before, had been shortened and more scant. A pinkish discharge for two weeks was of some significance. Two days before her physician called me, there had been severe pain in the right lower abdomen with perspiration, sudden pallor, vomiting, and a rapid and feeble pulse. Vomiting had continued, efforts to move the bowels had failed, and much tympany was present. Examination showed vaginal and breast signs of pregnancy, uterus not enlarged, no lateral enlargement could be defined. Large distension due to gas, probable clot in abdominal cavity. Hæmoglobin 50 per cent. Immediate operation in private department of Presbyterian hospital, under the diagnosis already suggested by her physician of ruptured extrauterine pregnancy. A tiny fœtal sac, not more than three-fourths of an inch in diameter, was found ruptured near the outer end of a very attenuated Fallopian tube. Two or more pints of blood clot free in the abdominal cavity. Right tube and ovary removed. Aseptic recovery.

In this case there was the similar history of sudden collapse as from internal hæmorrhage in a pregnant woman, but the distended abdomen, though difficult to examine, lacked the well-defined outline of a contained uterus such as was seen in the other patient.

# ARE GLOVES AND MASKS ADVISABLE IN MODERN SURGERY?

By E. STANMORE BISHOP, F. R. C. S.
Hon. Surgeon, Aucoats Hospital and Consulting Gynecologist Jewish Memorial Hospital, Manchester

All surgeons desire to be efficient. All surgeons desire to let nothing escape them that may tend to their greater efficiency. It may with equal truth be said that all surgeons are anxious to be thoroughly abreast of the times, and there is nothing they dread so much as the least suspicion that their methods are obsolete, or their technique wanting in any of the latest improvements which help towards perfect asepsis, or the obtaining of the best possible results from their work.

But such anxiety may easily lead to the adoption of methods, which are for the moment fashionable, but which do not tend to any real increase in efficiency; which may indeed, though at first sight appearing to be founded upon accurate facts, decrease their efficiency in other ways which are not so immediately obvious.

There is something very attractive to most minds about special uniforms, special costumes and special surroundings; and there is a spectacular impressiveness in the figure of a surgeon entirely covered, except for his eyes, in aseptic clothing; he looks like a high priest of surgery, and priests have in all ages been regardful of the effect of vestments upon their followers.

There can, however, be no doubt that real progress has been made by the use of many of these precautions. The days are long since past when the operator was only solicitous about the care of his own apparel, and if he took off his coat in order to operate, did so mainly for the preservation of that coat from stains and not for the greater safety of his patient. The removal of all external clothing, the donning of clean white drill jackets or gowns, trousers, and caps which have been carefully sterilized, and the substitution of rubber-soled shoes for the boots which carry in the mud of the streets, are all steps in the right direction. These measures ensure the absence of preventible micro-organisms in the dress of the surgeon and, duplicated by assistants and nurses, of all those present in the operating theatre. Thorough washing and scrubbing of arms and hands, first with etherial soap and water, to ensure what Moynihan calls "social" cleanliness, followed by one of the special methods of antiseptic treatment of the same parts, thoroughly carried out, ensures the absence of pathogenic bacteria from the integuments of the surgeon which come into actual contact with the wound.

The modern treatment by heat of dressings, instruments and sponges render these innocuous, and the present methods of protecting the tissues operated upon and their surroundings by sterile gauze, the avoidance of any handling of parts more than is absolutely necessary, and the holding of tissues by sterile forceps or clamps rather than by the fingers, all act in the same direction and tend to make and keep the raw surfaces and the exposed viscera aseptic.

All these have nothing but good effects; they do not hamper the work in any way; they rather help in safe, rapid, and efficient operating, but so much cannot be said of the latest developments of this otherwise admirable practice. Masks and gloves, however theoretically correct, do materially hamper the surgeon's movements, and therefore, may very easily do far more damage to the prospects of a safe recovery — which is after all the main end in view — than would result if they were omitted.

It is conceivable that men trained from the first to work in rubber gloves may in the end and after much practice be able to use their fingers as deftly as if they were bare, but this entails much increased risk to the patients upon whom they practice, since the dangers of an operation are not all removed when every single micro-organism is eliminated. There still remain the even greater dangers of excessive loss of blood from vessels not grasped with sufficient quickness by forceps held in muffled hands; the increased shock due to loss of time by less rapid stitching or delayed toilet; the less handy use of the knife or other instrument; the delay produced by the nipping of an assistant's or the surgeon's own glove; the loss of facility in tying ligatures or sutures; or any one of the multitudinous little impediments which every surgeon notices who operates in gloves.

And if this is so, even with men who have always been accustomed to them, these drawbacks are a hundred-fold increased when a surgeon, who has attained a high degree of facility with his bare hands, attempts the same work in the new and unaccustomed coverings. Needles, over which he has been used to have perfect control, slip and twist in wrong directions, the gloves hamper his ready action in the tying of ligatures; the threads of these same ligatures or sutures are not gripped with the old easy sense of security, and more and

more time of immense importance is wasted. It is time that someone had the courage to point out these things and regardless of the sneers of certain men, to show how the real aim of any operation — the recovery of the patient — may be endangered by the wish to appear academically complete.

And why should the surgeon handicap himself in this way? Is it so certain that, if he does, he will obtain even the end aimed at, the exclusion of micro-organisms from the operative field? By no means; such a result is at least very questionable. Gloves are made of various degrees of thickness; with any increase in their bulk, the sense of touch, and the facility in the use of the surgeon's hand, diminish; with any decrease, the chances of an unwary prick become greater. It has long since been shown that there is some difficulty in absolutely clearing the skin ducts in their entirety from micro-organisms. The wearing of gloves greatly increases any tendency of the hands to perspire; such perspiration carries any material present in these ducts, micro-organisms included, toward the surface, where it collects beneath the glove. In this fluid so confined, micro-organisms increase rapidly, so that any fluid retained there for half an hour becomes acutely poisonous. A chance prick of a needle through the thin barrier allows the discharge of this actively breeding fluid into the wound and the whole object of the glove is at once defeated. So far as the safety of the patient from sepsis is concerned, he or she would have been safer had the surgeon never worn any gloves at all, for now he has inoculated the wound with the very material most dreaded, in a concentrated form. It would be an instructive study, if only it were at all likely to be accurate, to determine in how many operations such pricking of the glove has occurred, and in how many it has not. It is probable that those of the former would immensely outnumber those of the latter class.

But this, it must be noted, applies only to the surgeon himself; the nurses' hands are not in danger of such pricks; nor are those of his assistant; not one of these auxiliaries requires to retain the keen sense of touch which is so essential to the operator himself; there is therefore no reason why they should not avail themselves of any additional precaution, rather every reason why they should; besides, as Lockwood points out, the thorough sterilization of the hands is largely a matter of practice and experience, so that it is most likely to be done satisfactorily by ; u rgeon himself; if it is not perfectly carried th e gloves are an additional safeguard.

Fortunately for us and for our patients, the normal resistance of the tissues to stray micro-organisms appears to have been greatly underestimated; for it would have been impossible for surgeons to point to hundreds of successful cases of serious operations as they now can, if success had depended upon "absolute" freedom from germs, or if it had been possible for two or three bacteria to induce septic poisoning. In saying this, however, it must not be imagined that any wish to disparage the utmost care in sterilization is suggested or intended; what is desired is, that a fair proportionate value should be given to *all* the factors which make for success.

For there appears to be a fatal facility in many minds unduly to exalt the importance of one factor in every surgical problem; to lose the sense of due proportion in things and, in their eagerness to attain to a theoretic perfection in one direction, to forget, if not altogether at least in great part, the equal if not larger importance of other things. Sterility is not everything; one may have a perfectly sterile operation and one's patient may lose so much blood that she cannot recover. Our persons, instruments, dressings and surroundings may be absolutely free from germs and our patient may die of shock from the unduly increased time under anæsthesia. An operative success is due to a combination of many things, not to the religious, I might say, the fanatical observance of any one factor.

And what is true of the use of gloves, may with almost equal force be urged against the use of masks. Theoretically, there is a great deal to be said for the practice; there is no doubt that the human mouth and nose contain many micro-organisms; no doubt that these are expelled to a slight extent even during quiet breathing; still more during sneezing, coughing, or loud speech. The observations of Flugge and Gordon have placed this beyond discussion. It would seem only reasonable that some barrier should be placed between these and an open wound; and there could be no objection were not the drawbacks produced — the drawbacks to the success of the operative work which it cannot be too often insisted upon is the one thing to be considered — equal or greater than the risks so encountered.

The surgeon's eye should be everywhere during operative work. There must be nothing to impede his vision in any direction. He himself should be comfortable and easy, so that there is nothing to distract his attention from the task he has set himself to do; no personal worry or annoyance to take his mind even for a moment away from the rapid and easy performance of his duties.

Will any one who has worn a mask venture dispassionately to affirm that this is the case when the lower part of the face is entirely covered? If the surgeon has to look down, his eyes are immediately caught by the white gauze and he has, for a time at least, to force himself to alter the focus of them. No doubt after prolonged use, he will cease to notice this, but meanwhile, he is handicapped to that extent. Then his breath is deflected back again against his face and escapes upwards towards his eyes with an unpleasantly warm sensation which tends at least to divert his mind from its proper object. Is this necessary? Because, if not absolutely necessary, it is very objectionable. Quiet breathing is not specially harmful; it is coughing, sneezing, loud talking that is dangerous. Are operators then in the habit of giving way to any of these during an operation? If a man feels that he is in danger of sneezing, can he not stoop below the table or for a moment leave it until the paroxysm, which is very rare, is over? As to talking, is not absolute silence during operative work now almost universally the rule in all well-regulated theaters? And clinical lectures and expositions of operative work can as easily be given before the patient's entry or after his departure as during the actual work; far better indeed, for, like every one else, no surgeon can talk and work equally well at the same time. In these cases, also, the primary object of operative work, not the instruction of students, but the recovery of the patient, should always be kept permanently in view.

But the necessity, which undoubtedly exists, for some barrier can be supplied in another way which does not involve all this discomfort. Small tufts of cotton wool placed in the nostrils will effectually prevent any escape of germs from those outlets; whilst a small respirator formed of two curved and perforated plates of celluloid between which a thin layer of cotton wool is laid, filters the breath of all objectionable particles. These do not hamper the surgeon in any way, they do not distract his attention; they do not make him personally uncomfortable, and whilst perfectly efficient, can be worn without annoyance.

If the surgeon is to wear a mask, it is but a logical sequence that the nurses should also be masked. But to this there is another and to my mind, and I feel sure to many others also, a still more serious objection. Many surgeons and all patients know the feeling of terror which frequently assails the latter just before anæsthetisation. I have known such terror to kill with the first whiffs of chloroform. Do we realise this, and are we going to intensify it by surrounding our patients with faces and forms which are unfamiliar and unknown and which suggest the antechamber of torture in some Spanish Inquisition instead of the cheerful, hopeful, pleasant faces to which they have become accustomed and in whom they have learned to trust? I protest that I, who know my own nurses so well, have had to look more than once before I have recognized the covered up figure before me. To cover the dress and hair is one thing; that is necessary and safe, but let us not convert our theaters into the semblance of Mohammedan harems or Spanish torture chambers, nor terrify our patients out of what little courage they still possess, but let them see around them the kindly, friendly faces whose eyes — and mouths — impart confidence and hope.

And indeed, although the same expedients might be adopted by the nurses as those suggested for the surgeon, if it were necessary, the danger from them is far, — very far — less than from those who are actually bending over the wound. They are farther away, and there can be no doubt that they are more silent.

It may be said that patients are nowadays always anæsthetised in another room than the theatre, the interior of which they never see; and that is true, but if the covering referred to becomes, as it seems likely to be, the rule, nurses are not likely always to defer the putting on of their masks until after the anæsthetisation of the patient. One nurse at least should be by the side of the choloroformist, and she will be, sooner or later, masked like the rest. We fail, I think, sometimes, to put ourselves in the places of those we operate upon. Let us ask ourselves seriously, if we, fading into unconsciousness, and looking up into the faces of those around for the security and confidence we feel that we are losing, are likely to find them in the white gauze masks surrounding us at such a moment?

And what we would not wish for ourselves, let nothing persuade us to do to those who trust their lives to us. Masks are not necessary, and they are very objectionable. The only thing that can be urged in their favour is the fashion that at present prevails of carrying one factor in the success of our work — academic sterility — to its ultimate logical perfection.

And so we revert to our original proposition. The perfection of one single factor may entail, nay, almost certainly will entail the neglect of others of an equal or greater value in the ultimate success of our work.

# UPON A CASE OF TOXÆMIC PERNICIOUS VOMITING OF PREGNANCY, WITH TOTAL NITROGEN AND AMMONIA ESTIMATIONS

By WALTER H. BUHLIG, B. S., M. D.
Instructor in Clinical Pathology, Northwestern University Medical School
AND
HERBERT M. STOWE, M. D.
Instructor in Operative Obstetrics, Northwestern University Medical School, Attending Obstetrician, Cook County Hospital

A. B., aged 19, entered the service of Dr. Stowe in the Cook County Hospital and complained of constant nausea and vomiting. The history of the case was as follows: The patient was a primipara of good family and personal history. Immediately after conception, nausea and vomiting began and continued for nearly three weeks, but only in a mild form. During the fourth and fifth months of gestation, the condition improved markedly. From the beginning of the sixth month, the nausea and vomiting recurred and continued uninterruptedly until the present time. All foods taken in the morning and evening were ejected within ten or fifteen minutes. A few light articles were retained. The patient was then eight months pregnant. Headache was complained of at frequent intervals. Neuralgias in the face, arms, and pelvis were common. The vision was blurred occasionally.

Upon physical examination, the patient was found to be eight months pregnant. The fœtus was alive and presented by the head. Severe pain was elicited over the right hypochondriac region. The liver was tender on pressure, and extended slightly below the costal arch. Deep palpation in the region of the right kidney caused exquisite pain. The skin was covered here and there with areas of dermatitis, varying in size from a pea to a walnut. The favored location was on the back and abdomen. The margins were distinct, and did not disappear under pressure. The eruption was the typical toxæmic rash frequently seen in pregnancy. The tongue was coated, the breath foul, and appetite was poor. The bowels were usually constipated, but relieved themselves by occasional attacks of diarrhœa. There was a moderate œdema of both ankles, extending up as high as the upper third of the leg.

The patient was placed upon a milk diet in bed for a week, but improvement was very slow. Vomiting continued, though to a less extent than before. The temperature varied from 99.8° to 102.6° F. The pulse reached 120 several times. The tension was stationary, ranging from 170 to 180. After remaining in bed for eight days, the induction of premature labor was determined upon and the Voorhees's metreurynter was introduced above the cervix. In eight hours the uterine contractions became strong and regular, and a live child was born spontaneously. It weighed six and one-half pounds, and died in twelve days of acute gastro-enteritis. The mother made a fair recovery after the termination of gestation. The vomiting ceased on the sixth day and the patient left the hospital on the fourteenth day of the puerperium.

Since this was a typical toxæmic case of pernicious vomiting of pregnancy, and remembering Williams's finding of high ratio of ammonia to total nitrogen, such determinations were made (Buhlig) in the urine at the clinical laboratory of the Northwestern University Medical School, using Folin's method of delivering the ammonia by a strong stream of air and the Kjeldahl, for the nitrogen. The result is briefly this:

$$\frac{\text{N of } NH_3}{\text{Total N}} = \frac{20.16}{235.2} = \frac{8.6}{100}$$

Other data from the general urine examination of the same specimen is as follows:

Specific gravity, 1005; urea (Doremus), .5 per cent; faint positive test for albumin; no bile, no blood, no sugar, no acetone, no casts; considerable number of pus cells.

In a case, therefore, that is clinically of the toxæmic type, the relation of ammonia to the total nitrogen is not far from the normal.

The urine examined was only a single specimen, obtained by catheter on the afternoon of the operative interference and examined the next forenoon. Thymol was used to prevent decomposition. This substance was used by Camerer (Der Gehalt des mensch. Urins an stickst. Körpern, 1901), and was found very trustworthy by one of us (Buhlig) in a number of tests of urines made fresh and at intervals of 24 and 48 hours. Though a 24-hour specimen would have given more accurate conclusions, it is just to assume that the relation of ammonia to total nitrogen remains about the same in each specimen.

# DEPARTMENT OF
# NICHOLAS SENN FESTSCHRIFT

## A CASE OF LINITIS PLASTICA OF THE STOMACH (BRINTON) CURED BY JEJUNOSTOMY

By PROFESSOR A. FREIHERR VON EISELSBERG

Translated by ANNA M. BRAUNWARTH, M. D.

I GLADLY accept the invitation of the Nicholas Senn Club to participate in the Festschrift in honor of my highly esteemed colleague Senn. I have chosen a case in abdominal surgery, a subject which has been much advanced through Senn's work. The case seems to me to be of unusual interest on account of its rarity and of the result obtained.[1]

A widow, 41 years old (whose husband died of sarcoma), had peritonitis when she was 17 years old, since then she has been well and has devoted herself to athletics. During the first year of her marriage she aborted in the seventh month, in consequence of a fall from a wagon. She was never pregnant after this. She laced tightly and occasionally indulged in alcohol. In 1899 the patient weighed 72 K. At this time she began to suffer from pressure in the stomach, which at times was followed by vomiting. In 1900 she consulted a physician who had just returned from a course at Carlsbad, and referred all the symptoms to the nervous system. In spite of remaining in the mountains and diligently exercising every day, she was no better; on the contrary her symptoms were worse (the pressure in the stomach, the loss of appetite and the vomiting). For a short time in the spring of 1901 she sought medical advice in Meran (Südtirol). Here, for the first time, a physician made the diagnosis of an abnormally located stomach. On milk diet she lost weight. Later while in Vienna she had massage applied to the stomach but still without result. In October, 1901, she consulted Professor Neusser. On his advice the vomitus was examined, but the examination showed nothing abnormal. Electricity was given the stomach daily; during these treatments a hardening in the stomach often appeared. Rich milk diet was ordered.

In January, 1902, the body weight was only 55 K. The pressure in the stomach, the anorexia, and the frequent vomiting continued; at times there was sweating and an evening temperature of 38.8 C. Examination of the blood and urine gave no abnormal results. At this time appeared for the first time after digestion a sensation, as it were, "of narrowing of a valve which did not allow the food to pass freely." If the food was not digested, nausea, pressure in the stomach, and vomiting occurred. As the menses were irregular and profuse, a gynecologist was called in consultation. He found swollen, inflamed adnexa, and advised an operation, since he believed that the trouble in the stomach depended upon the diseased adnexa.

In a consultation with Professor Neusser and Dozent Dr. Klein, in which I was also called, it was decided that there was probably an hour-glass contraction of the stomach, and that on account of inflammation, the stomach had become fixed by adhesions. The stomach contents gave very little mucus. The stomach itself could hold only a small quantity of fluid.

The patient was advised to have a laparotomy in order to cure the trouble. She willingly consented. The operation was performed by me April 20, 1902, at the Sanatorium Löw. The patient before the operation weighed 57 K., otherwise she was healthy.

Billroth's mixture was used for the anæsthetic. A median incision was made. On opening

[1] This case has until now, been but briefly mentioned, and then in the work of my pupil Lempp (Ueber den Wert der Jejunostomie, Arch. f. Klin. Chir., Bd. 76, Heft 2).

the abdominal cavity, the stomach was found to be bound down on all sides to the abdominal walls by a mass of adhesions. The stomach could not be brought into view until these adhesions had been ligated and separated. The stomach presented itself as a long narrow sack. Its width was the same as that of the transverse colon. On all sides it was bound down by firm adhesions to the anterior abdominal wall, the pylorus, the hilum of the liver, the under surface of the liver, the omentum, and the transverse colon. These adhesions in some places were merely fine threads, in other places they formed stout strings and dense bands. They were separated, and when necessary a double ligature was applied.

Between the adhesions, the surface of the stomach had a peculiar appearance; it was covered with a network of scars, so that the wall of the stomach looked like knitting work. There was very little normal tissue. The most marked pathological changes were in the pyloric portion. The stomach seemed like a tube with stiff walls, which required much force to compress. An ulcer was not felt anywhere. The stomach wall was from one-half to one cm. thick, the thickest portion being at the pyloric end. After freeing the adhesions the surface showed slight bleeding in many places. Since there was not sufficient normal tissue present, it was necessary to give up the plan of a gastroenterostomy. Inasmuch as a fistulous opening had not been suggested to the patient before the operation, the abdominal wound was closed after carefully controlling the bleeding.

This operation could not be very promising. The result was as follows: After a few days when they began to feed carefully by mouth, the patient vomited everything. The wound healed per primam. The patient remained free from fever, but owing to the frequent vomiting, she lost ground, so that 14 days after the first operation she weighed only 50 K. At this time a gastric fistula was suggested to the patient and she willingly consented to this plan.

May 8, 18 days after the first operation, a second laparotomy was performed. (Billroth's mixture was used for the anæsthetic.) On opening the abdominal cavity the serosa appeared glistening, and there was no peritonitis. A jejunostomy was quickly made according to the Witzel method, which I have previousy described.[1]

The operation was completed in fifteen minutes. The patient was much pleased with the artificial feeding since she was now free from the severe vomiting. She was up on the 12th day, and was entirely free from suffering. The abdominal wound healed. On the 22nd day, the patient left the sanatorium, having gained 6 K. since her second operation. The daily feeding of the patient through the fistula was carefully looked after by the physician in charge, Dr. A. Klein. I also thank this physician for the report of the condition of the patient afterwards. From June 1st to the end of September, 1902, the patient was fed through this fistula, the daily amount of nourishment was 1500 to 1800 c.cm. of milk, 200 to 800 meat broth, this giving an average of 2100 c cm. (2000–2300) of liquid nourishment. To the milk and soup were added 4 tablepoonsfuls Nestle food, 10-20 gr. beef tea, some gruel, 8–10 eggs, 2 teaspoonsful of tropon, 1–2 teaspoonsful somatose, 1 teaspoonful fersan, some gruel, and, off and on, 1–2 teaspoonfuls of oil.

The quantity given from 6 A. M. to 10 P. M. was divided into 8–9 portions. In order to show how the artificial nourishment of the patient was carried out I give this example.

6 A. M., 300 gr. milk, 1 egg; 8 A. M., 300 gr. milk, 1 egg; 10 A. M., 300 gr. milk, 2 tablespoonfuls Nestle food, 1 egg, 1 teaspoonful somatose, 2 tablespoonsful of oil; 12 M., 15 gr. meat broth, 10 gr. beef tea, 1 egg, 1 teaspoonful somatose and some gruel. 2 P. M., 150 gr. meat broth, 1 egg and 1 teaspoonful tropon; 4 P. M., 300 gr. milk, 1 egg, 1 tablespoonful Nestle food, 1 egg and 1 teaspoonful tropon; 6 P. M., 300 gr. milk, 1 egg, 1 teaspoonful fersan; 8. P. M., 150 gr. beef soup, 10 gr. beef tea, 1 egg and some gruel; 10 P. M., 300 gr. milk and 1 egg.

During this time only condiments were given per mouth (milk, coffee, some liquid vegetable soup, tomato, spinach), small quantities of beer and one-fourth to one-half of sour wine were taken.

In the summer of 1902, iodine was given the patient in order to determine if there was any possibility of a syphilitic basis for this stomach trouble.

From October, 1902, there was no change in the nourishment, except the somatose and

[1] Uber Ausschaltung inoperabler Pylorus-Stricturen nebst Bemerkungen über die Jejunostomie. Arch. f. Klin. Chir., Bd. 50, Heft 4.

fersan were omitted. In the place of these foods a little cheese was given by mouth at night. The patient gave up these foods unwillingly. Since the beginning of January, 1903, she had regained her former weight, 72 K., the diet was somewhat changed. When the patient limited herself to the above-mentioned diet taken by mouth, she was free from pain and she never vomited. Later at times when she attempted to take solid food, she said: "I vomited five or six times October 1902 to March 1903, and I could have prevented it if I had not eaten something which I knew would distress me."

The patient was married about one year after jejunostomy; she was then in her 43rd year.

The highest weight after systematic feeding was 82 K. Her menses ceased after the operation. The fistula is still patulous, the surrounding skin is normal. At first the fistula carried a large No. 7 catheter, a No. 4 could be passed; this catheter was worn permanently without incontinence ensuing. Every two or three days this catheter was taken out for two or three hours, but if out longer it was almost impossible to replace it without the help of a physician. The general findings of importance: Her present weight, May 1907, that is, six years after the operation, is 76 K.

During these five years the nourishment was taken regularly through fistula and mouth.[1]

White meat is generally digested more easily than dark meat. In spite of these remarkable improvements, the capacity of the stomach is very limited, any deviation from this is immediately felt; there is a sensation of pressure upwards and nausea. The patient realizes it is better to keep within the bounds than to overstep these limits.

The patient makes this interesting statement, that she is worse in cold weather than in warm weather. The bowels are regular; if ever it is necessary to give anything for the bowels, the easiest way is to add a teaspoonful of oil to the nourishment which is given through the fistula. This year (1907) the patient celebrated the anniversary of her operation by going to Mariazell. On account of the room in the hotel being very cold, the patient for the first time neglected to take her nourishment through the fistula and lived for four days on food taken only per os. Unfortunately, she was not regularly weighed. The patient is convinced that she noticed no marked loss of weight. Thereupon the patient planned for 8 days to omit taking nourishment through the fistula, at the same time watching her weight. She had a rosy color.

The essential points in this case are that a spontaneous stenosis developed, that before the operation one could palpate a tumor, and the operation showed perigastritis. There were thick adhesions which extended over the wall of the stomach, the stomach itself was changed to a narrow tube with thick walls, and on the surface there was no normal tissue. The surface was covered all over with a network. Nowhere were there any real contraction scars to be seen on the stomach, but the whole organ was markedly shrunken. Since the exploratory operation was not completed, it was not possible to determine microscopically the condition of the stomach wall. The diagnosis of hour-glass contraction of the stomach which was made before the operation, was incorrect; in addition to the stenosis of the stomach there was also an insufficiency of the pylorus. The duodenum and jejunum were found inflated.

Since the continued loss of weight demanded an interference, laparotomy was performed.

Gastrolysis (without opening the stomach) led to no permanent results, as was to be expected.[2] On the other hand, jejunostomy immediately relieved

[1] *Per fistulam pro die:* 7 A.M., 500 gr. milk and 3 teaspoonsful Nestle meal and 2 yolks of eggs. 10 A.M., 500 gr. milk, 4 yolks of eggs. *Per os pro die:* 10 A.M., 200 gr. coffee and one small roll, ten minutes after a small piece of bread and butter, some ham and sausage. 1:30 P.M., several spoonfuls of soup, a small piece of meat or brain, some vegetables and pudding, ½ cup of black Mocca coffee and small amount of fluids. Lunch — 1 cup coffee, 1–2 pieces coffee cake; ½ to 1 hour later, cup chocolate. Supper — small piece of meat, small quantity of cheese, 2 to 4 radishes, ½ to 1 beer and 1 to 2 oranges.

[2] Usually I have had bad results with gastrolysis. Vide Clairmont, Bericht über 258 von Prof. v. Eiselsberg angeführte Mazenoperationen. Arch. für klin. Chir., Bd. 76, Heft 1.

this condition, so that the patient has been practically well since her operation five years ago, although the stomach has never regained its former capacity; hence the greater part of the nourishment is taken through the fistula, which in this case has remained patent. This is the usual result of a jejunostomy by Witzel's method. The character of this condition should next be considered. It depends upon a diffuse process resulting in the narrowing of the stomach and a contraction of the organ.

On the consideration of the patient's condition and the history of the case, the most important cause for the contraction of the stomach (scirrhus cancer) could be safely excluded as well as the shriveling of the stomach after toxic gastritis or the cicatrix following phlegmasia of the stomach. (V. Cackovic.) The supposition that it was of syphilitic origin (Hemmeter and Stokes)[1] was also dismissed.

The fact that pain, which is so common in ulcer, was not present as well as the absence of the typical vomiting and of blood in the stools spoke against the supposition of a typical gastric ulcer, although this often results in a diffuse shrinking of the stomach. In addition, the therapy described (diet) gave no results. The operation showed no contracting scars on the stomach itself, but rather diffuse changes spreading over the whole stomach.

On looking through the literature, it seems to me very probable that this is one of those cases described by Brinton, in which the most marked change is found in the connective tissue elements of the stomach, "in which the stomach cannot contract, but remains a rigid tube; accordingly, the capacity is diminished so that finally it holds scarcely more than 5 or 6 cubic inches. In short, as the volume of the stomach decreases, the walls themselves thicken in proportion." Therefore, this plastically inflamed connective tissue is changed into a network which is covered with vessels. Britton has claimed the name of plastic linitis for this disease. As in our case, it extends over the whole stomach. This disease is very seldom seen, it is localized chiefly in the pylorus Brisaud.[2] (Oettinger.[3]) Our case was not like that described by Hanot and Gombe[4] and the one described by Kahlden.[5] This case was somewhat similar to that described by Nothnagel[6]).

It is not easy to specify the cause of the linitis in our case. The test for syphilis failed or rather came to a standstill, although it is possible a sufficiently light dose was not used.

Perhaps this case followed the course of a typical peptic ulcer! It is very exceptional for an ulcer to cause a narrowing of the stomach and the binding of this organ by firm adhesions to the surrounding structures (Budd[7]). Since Lebert[8] in one case observed as many as 20 such ulcers, it is conceivable that similar multiple ulcers diffusely located cause contraction of the stomach.

[1] Chronisch hyp. Gastritis luetischen Ursprungs in Verbindung mit hypert. Pylorus Stenose. Arch. f. Verdauungskrankheiten, 7, 1901.

[2] Die Krankheiten des Magens (aus dem engl. bericht von D. Baum 1862) Linite plastique. Semaine med. 1900.

[3] De la Stenose hypertrophique (Semaine med. 1902).

[4] Etude sur la gastrite chronique (Arch. d. phys. normale et path. 82).

[5] Ueber chronisch sclerosirende Gastritis (Centralblatt 1, Kern. Med. 1887, F. 16).

[6] Cirrhotische Verkleinerung des Magens und Schwund der Labdrüsen unter dem Bilde der perniciösen Anæmie Deutsch. Arch. f. klin. Med. 24, 1879.

[7] On the Organic Disease and functional disorders of the Stomach. London, 1855.

[8] Anatomie, p. 174. 7, ii.

# EDITORIALS


## SURGERY, GYNECOLOGY AND OBSTETRICS

EDITORIAL AND BUSINESS OFFICES
103 STATE STREET . . CHICAGO, U. S. A.

PUBLISHERS FOR GREAT BRITAIN
BAILLIERE, TINDALL & COX,
8 HENRIETTA ST., COVENT GARDEN, LONDON, W. C.,
ENGLAND

SUBSCRIPTION, PER ANNUM, IN ADVANCE
United States and Canada . . . . $5.00
Foreign Countries . . . $6.00 (25 Shillings)

Managing Editor . FRANKLIN H. MARTIN, M.D.
Associate Editor . . ALLEN B. KANAVEL, M.D.

AUGUST, 1908


### THE IMPORTANCE OF THE PRINCIPLES OF SURGERY

Both the physician and the surgeon need to have their principles of action ever ready for use. Yet the insistence of the surgeon's need in emergency is so great and he is so frequently in such positions as are distressing to him and hazardous for his patient that it would seem almost more important for him to be prepared for the emergency when thinking must be done with lightning rapidity than for the physician to be thus fortified. At the present time, when, on account of the multiplication of facts, the need for the formation of great concepts and important principles appears most urgent, it seems that principles are most neglected. This is not to be wondered at when we consider that the human mind is so constructed that the acceptance and assimilation of facts is easier for it than the evolution or the comprehension of general principles and that, even when great concepts have been presented, they are entertained by the mind only with difficulty, unless there is especial aptitude or training for such work. In no department of thought do young medical men display wider differences of mental activity than in this work of studying and applying, at least in theory, the principles of our art. The selective action of academic education is evident here, as is also to be seen the effect of training in abstract thought.

It is unfortunate that the principles of surgery are not to-day more insistently taught and studied than is the case, for a number of reasons. By the principles of surgery we mean those great concepts which pertain to and embrace the theory and conduct of our science and art. To study these principles is to expand and train the mind. With but little modification our system of education might have a far more liberalizing effect than is now the case. By a liberal education we mean one which confers freedom — one which breaks the shackles that enslave the mind. A man who is thus freed can dominate the intellectual sphere in which he moves; he can learn, he can teach, he can favorably influence the men of his country, and of his time. The easy pursuit of simple facts in science ought to yield to the search for those great central truths that embrace, include, and, as it were, simplify facts. A valid principle may include a thousand facts. A man who has assimilated and can call into subjective reality such a principle may instantly classify and, as it were, annihilate a thousand facts. All departments of medicine ought to be presented and taught from the conceptual, not from the objective point of view. This would mean an entire reversal of present-day methods of teaching medicine. Principles, illustrated by a few facts, would be taught first, the bulk of the facts afterwards. A small volume would suffice for the presentation of the principles of

surgery and an ample discussion of them. An encyclopedia is necessary to deal with the facts of the subject.

To be sure, the facts must be studied and must be presented in orderly array. But does the innocent layman suppose it is facts upon which the operator depends when he stands in the presence of disease and the dire emergency? The surgeon knows in his heart that the reason he is calm, strong, and capable is not because he could at any moment pass an examination upon the minutiæ of the anatomy, physiology, and pathology of the part which he is to operate upon, but because he knows that if he encounters this great class of morbid conditions he will act in this way, and that when that wide category of emergencies is before him he will find refuge in such a method of treatment or attack.

The bane of all modern science is facts, inadequately classified, ill-digested, and imperfectly wrought into principles. Let us surgeons return to the more philosophic attitude of our forefathers and lay more stress than has for long been done upon the foundations of our science and art in those general principles which easily include facts and make them practically available. WELLER VAN HOOK.

---

## MEDICAL RESEARCH AND THE UTILITY OF A BIBLIOGRAPHY

Medical literature chosen with care brings to us the motto of an old Egyptian King who wrote over his library, "The Medicines of the Soul."

There are various objects among writers; some for gratification of curiosity; some for the love of fame; some for the pleasure of dispute; some for the necessity of supporting their subject.

There are few original thinkers in the medical world, or ever have been. The majority of the so-called medical philosophers have usually adopted and supplemented the opinions of those who went before them.

The selection of a subject is to the author what choice of position is to the general; once skillfully determined, the battle is already half won. We must choose our authority as we choose a friend. If you have knowledge, let others light their candle at it.

If one thoroughly knows anything, he must teach it to others by means of medical literature, which communicates facts, investigations, and conclusions. This defines the medical profession as the calling of those who add to the value of their practical work by sharing their experiences and opinions with their co-laborers through the medium of medical journals.

Medicine is never too old to establish facts, no matter how ancient it may be; if nothing else, it teaches us how to think, what to think, to improve our minds so as to enable us to refresh our memory with the thoughts of other men, and bring forth something for ornamenting our work of to-day. The medical literature of an age is but the mirror of its prevalent tendencies.

Knowledge and timber are hardly ever used until they are seasoned.

It is wise to get the knowledge and learning from every source to bring out the verification of a subject. A genius was once asked how he came to know so much about everything. He replied that he constantly realized his own ignorance, and was never ashamed to ask questions.

A good article written even a hundred or more years ago is a message to us from the dead — from human souls we never saw, who lived perhaps thousands of miles away. Yet these leaves of paper teach us that which we are trying to acquire.

Good literature, like proverbs, receives its chief value from the stamp and esteem of the

ages through which it has passed; it represents the author; the writer is always greater than his work.

The thought that comes from a great thinker is a ship heavily laden, deep freighted with truth and beauty.

Abstracts, quotations, abridgments, summaries, etc., have the same use as burning-glasses, to collect the diffuse rays of wit and learning in authors, and make them point with warmth and quickness upon the reader's imagination.

The truth-searching reader cannot but be impressed with the author's labor and expense for the accurate information that has been done for him, for the sake of saving labor for those who live after him.

We ought never to be afraid to repeat an ancient truth, when we feel that we can make it more striking by a neater turn, or bring it alongside of another truth which may make it clearer, and thereby accumulate evidence. It belongs to the inventive faculty to see clearly the relative state of things, and to be able to place them in connection; but the discoveries of ages gone by belong less to their first authors than to those who make them practically useful to the world.

Every age is a problem when solved by a later age. The present writer calls the attention of his readers to the learning which a previous author has left behind him unfinished, and so advances the literature of his own age.

It would be utterly impossible for one person to acquire a complete knowledge of the medical literature of the present day. It has undergone a vast change in a half-century. Half a century ago, medicine was confined to the language of the country in which the article was written; now it is translated into innumerable tongues and becomes the common property of all practitioners.

It is medical literature that has united the brotherhood of medical men into one common family; we know the dead authors as well as the living.

This generation enjoys a vast hoard of medical learning, bequeathed to us by antiquity, and which is transmitted — augmented by our own acquisitions — to future ages.

To use this store rightly is to go to it for help; to appeal to it when our own is inadequate; and to receive from it the united sentences of the judges and councils of all time against our solitary and unstable opinion.

There is no literature so poor that it would not be a prodigy, if wholly wrought out by a single mind without the aid of prior investigators.

All past medical writing is the faithful mirror that reflects to our mind the minds of sages and heroes in medicine. Death has no dominion over them; they live, and their influence lives forever. Our best thoughts come from others. We quote others to better express ourselves. To creep along the shore of other authors is like gathering honey from many flowers. Quotations are the parole of medical men the world over.

The progress of medicine in the future depends upon the observation and the voicing of the past. But all this past writing for our benefit is but waste paper, unless we spend in action the wisdom we get from thought.

The best medical literature for a writer is not always that which great men have written; more often it is that which meets our peculiar wants, the natural thirst of one's mind; *that* awakens interest and rivets thought.

Medical literature is the common property of the medical profession; it matters not in what quarter of the globe or in what language it may have been written.

Learning without thought is labor lost, just so is it in writing without research. There is no article so poorly written but something val-

uable may be derived from it. The writing that helps us the most is that which makes us think the most. Good language is the instrument of science; words are but the science of ideas.

The habit of committing our thoughts to writing is a powerful means of expanding the mind, and producing a logical and systematic arrangement of our views and opinions. It is this which gives the writer a vast superiority, as to the accuracy and extent of his conceptions, over the mere talker.

No one can ever hope to know the principles of any art or science thoroughly who does not write as well as read upon the subject.

The multiplicity of writings has become so great, that everything must be reduced to abstracts.

To make a theory acceptable, you must make the words sparkle, so they may refresh the mind, and make it crave for more.

The spirit of a good article will inspire us with noble and manly thoughts.

Medical journalistic articles are the legacy that genius leaves to mankind to be delivered down to generations yet to come.

In making researches in literature, we must first have knowledge, secondly the power. The function of the first is to teach; that of the second is to impress; the first is a rudder, the second is an oar or sail.

The language of a writer is the dress of thought, the armory of the human mind.

Writing in a medical journal is not like writing in a book; when the publishers are the kings, the critics the knaves, the profession the pack, and the poor author the mere table or thing played upon.

Medical journals and monographs are the tools of a writer, and the greater the variety, the greater the help to our literary work. Text-book citations to a progressive physician are an abomination, and will not be tolerated. Text-books that contain the whole domain of medical knowledge are things of the past. To quote from text-books is an acknowledgment of illiteracy, unless it is something of originality which has not formerly been disclosed.

It is poor judgment in a writer to depend upon published abstracts if he is unable to find the original; such abstracts are liable to mislead. An abstract may have been made to suit the person or his purpose. Or the person abstracting it may have been incompetent to give the salient points of the original.

It is to be regretted that the language of medicine is not confined to one alone. There are about 400,000 recognized physicians in the world, and about 20,000 contributors to 1,000 medical periodicals, in more than 20 different languages, viz., Greek, Latin, English, German French, Italian, Spanish, Portuguese, Dutch, Danish, Swedish, Norwegian, Finnish, Russian, Polish, Bohemian, Servian, Roumanian, Hungarian, Bulgarian, Arabian, etc., and of late years Japanese, since their medical system is said to be so rapidly perfecting itself.

What chance has the busy physician with this flood of literature? And yet to hold his place in the foremost rank he must be abreast with it. He *must* have a bird's-eye view of what is going on in the medical world — his world. This is an age of the specialist. The one who works right along in his own line but calls in and assimilates extraneous aid. Here is where the competent collaborator comes in; the scientific man of letters whose profession or calling it is to make these researches and hand them out — much in little — ready for instant appropriation and use.

The busy practitioner may or may not be conversant with German, French, Italian, Spanish, etc., and yet he is anxious to know of late discoveries, and interesting cases that are daily chronicled. The rarer the subject, the greater the knowledge demanded to find widely scattered records. The gathering of all refer-

ences bearing on the given subject is not only a knack, but absolutely an art. It requires a genius of both philological and medical attainment. The average physician does not possess this learning. It takes close research to bring out from obscure literature the points which are desired, and they must be well authenticated and proven. The great libraries must yield their aid to this. There is a sort of physiognomy in the titles of subjects that appeals at once to the skillful observer so that instantaneously he knows what to abstract. These quotations preserve as in a vial the purest efficacy; they are extractions of the living intellect that bred them.

The most ancient classic literature is always modern since it is found in the newest works. And does this research require patience? Not only patience, but a vast amount of that commodity. Often important articles are mentioned that have fairly to be dug out of surrounding matter. It takes a book-worm to burrow for these hidden treasures. No higher compliment can be bestowed on an author than to quote him. To select good things from all others is equal to inventing new ones. To quote properly requires taste, judgment, and erudition; a feeling for the beautiful, appreciation of the noble, and a sense of the profound. Unless one is accustomed to research work, he will find himself at sea; he is a sailor without a compass.

Medical collaborators or bibliographers have their quacks no less than medicine, and they are divided into two classes: those who have erudition without genius, and those who have volubility without depth; we get second-hand sense from the one, and original nonsense from the other.

No searching examination guards the entrance to the profession of a bibliographer, and no special diploma is demanded of those who wish to practise it.

Unlike medicine and the law, literature seems to call for no particular schooling. Apparently, the possession of pen and ink and paper is enough, and the practitioner is then free to communicate by means of books whatever facts, ideas, and emotions he may happen to have stored within him ready for distribution to the world at large.

The occupation of a bibliographer is not for those who long for the flesh-pots of Egypt, as it is not for those who dwell in Bohemia, which is a desert country by the sea. It is not for those who do not enjoy its toil and who do not love it for its own sake. It is not for those who are thinking rather of the wages than of the work. Above all, it is not for those who have a high standard of wages and a low standard of work.

A medical collaborator or bibliographer should understand pathological descriptions so as to be able to classify his cases that when he reads a descriptive microscopical specimen, he should be able to differentiate from the description whether the case is a carcinoma, sarcoma, myoma, patholoma, adenoma, glioma, endothelioma, etc. Those cases fifty years ago were mostly all headed under the term of "cancer."

A bibliographer must also know synonyms of Botany, Pharmacy, Chemistry, Biology, Anatomy, Physiology, Histology, Pathology of Diseases, Injuries, etc., so as to be able to search under the various nomenclatures; as per example, I have lately made a research on the subject of Gastrotomy for "hair-ball" in the stomach. I found but nine cases under that term, but when I looked up under the synonyms of Bezoar, Trichobezoar, Pilobezoar, Phytobezoar, and under concretions of the stomach or intestines, which are technically termed, Aegagropilus, Gastroliths, Enteroliths, Avenoliths, or Evenoliths, I was able to collect about fifty or more cases. The foregoing

example corroborates my belief that medical research should and must be made by thoroughly trained medical men, and by one who is a lover of books and the possessor of a scientific mind, and must have practical good sense.

To make bibliography — to say nothing of medical digestive abstracts — is not a work to be lightly and carelessly entered upon.

The compilation of collective bibliography depends for its accuracy upon the education of the collector. He should, besides his honorarium, receive credit for his assistance. To publish a bibliography made by a collaborator without acknowledging credit for his assistance should be considered a sort of plagiarism.

To send an office girl to a library to make a medical research is to tempt fate. It may endanger the reputation of the author who embodies it in his publication; and it may be an extract so garbled as to approach the bounds of criminality.

How many office girls — yes, physicians even — know anything about other bibliography than that which is found in the "Index Medicus" and the "Index Catalogue of the Library of the Surgeon-General's Office"? The following is a list of fifty additional bibliographical works to prove my assertion:

Alphabetical Catalogue of the Library of the Manchester Medical Society, Alphabetical Catalogue of the Library of the Faculty of Physicians and Surgeons, Glasgow, Annales Tables alphabetiques par ordre de matières et par noms d'auteurs, etc., Bibliographie des sciences médicales, etc., Bibliotheca anatomica, etc., Bibliotheca botanica, Bibliotheca Britannica, Bibliotheca chirurgica, Bibliotheca medicinae practicae, etc., Bibliotheca medico-chirurgica et anatomico-physiologica, Bibliotheca medico-chirurgica et pharmaceutico-chemica, etc. (Holtrop), Bibliotheca medico-chirurgica pharmaceutico-chemica et veterinaria, etc., Bibliotheca medico-historica, etc., Bibliotheca therapeutica, New Sydenham Soc., Biographischer Lexikon der hervorragenden Aerzte aller zieten und Völker, Catalogue de la bibliotheque précreuse médicale de feuse (Davidsoniana), Catalogue des sciences médicales. (Bibliothéque nationale), Catalogue of scientific papers compiled and published by the Royal Society, London, Catalogue of the Library of the Royal College of Physicians of Edinburg, Catalogue of the Library of the Royal Medical and Chirurgical Society, London, Catalogue raisonne of the Medical Library of the Pennsylvania Hospital, Catalogue bibliotheca medicae, Classed catalogue of the books contained in the library of the Royal College of Surgeons, London, Dictionnaire des sciences médicales, Dictionnaire encyclopédique des sciences médicales, Dictionnaire historique de la médicine ancienne et moderne, Die Medicinische Weltliteratur, Encyclopädische Jahrbucher der Gesammten Heilkunde, Handbuch der Bücherkunde für die ältere Medicin, Jahrbucher der in- und ausländischen gesammten Medicin, etc., Jahresbericht über die Fortschritte der gesammten Medicin in allen Ländern, Jahresbericht über die Leistungen und Fortschritte in der Anatomie und Physiologie, Jahresbericht über die Leistungen und Fortschritte der gesammten Medicin, etc., Lehrbuch der Geschichte der Medicin etc., Literatura medica digesta, etc., Medicinisches Schriftsteller-Lexikon etc., Minerva, Jahrbuch der gelehrten Welt, Museum disputatorium physico-medicum etc., Név-és tárgymutatoja (Index of names and subjects), Nouveau dictionnaire de médicine et de chirurgie pratique, The Medical Digest, or Busy Practitioner's Vademecum (Neale).

CARL H. VON KLEIN,
Artium Magistro Medicinarum Doctore.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

A regular meeting was held February 7, 1908, with the President, Dr. A. J. Ochsner, in the chair.

Dr. William Fuller read a paper entitled "Intra-abdominal Rotation of the Great Omentum Unassociated with Hernia; Report of a Case" (p. 231).

### DISCUSSION

Dr. D. A. K. Steele: I have been exceedingly interested in listening to Dr. Fuller's paper. It is a very full and comprehensive compilation of all that is known on this subject up to this time.

Some eight or ten years ago, I had a case of twisted great omentum in which I made an error in diagnosis similar to the one cited by Dr. Fuller. The patient was a rather fat, middle-aged policeman who was admitted to the Mercy Hospital, having been sent there by me for an operation for a supposed recurrent appendicitis. At the operation I found a curious condition that I had not recognized at the time, and that I never quite satisfactorily explained to myself. The abdomen contained a good deal of bloody fluid. The omentum was enormously enlarged. It was twisted and convoluted and it was adherent on the right side, and the veins particularly were enormously dilated. The whole omentum had a bluish appearance, was greatly hypertrophied and seemed very much like bunches of grapes, or it had an hydatiform appearance. I resected the omentum, mopped out the abdomen, closed it up and in two or three days the patient died. That was the only case I have seen, and in that case I believe the twisted omentum was due to an old hernia on the right side to which the attachment had been made. The appendix was somewhat pathologic, but the real pathology was in the twisted omentum in this case. As I have previously said, I did not make a correct diagnosis and even after opening the abdomen I was not ecrtain as to the exact pathology.

With reference to the causation of these cases, I do not at this moment feel like accepting the explanation that has been offered by Dr. Fuller, at least not fully — that these cases of intra-abdominal torsion occurring in the great omentum must necessarily be due to the attachment of the distal end of the omentum and rotation then occurs more readily. That is true undoubtedly in a considerable number of cases. It is true in all hernial cases, but those are excluded from the type of cases with which this report deals particularly. When we consider the vast number of cases of attachment of the distal end of the great omentum and the very small number of cases of twisted omentum, it would seem to me that there must be other causes and that circulatory changes possibly occur in the omentum. There may be a pathologic condition of the omentum due to dilatation and varicosity of the veins and this may be more likely a true explanation, or an additional explanation, at least. Every one of us has seen many cases of attachment of the omentum and only a few of us have seen cases of torsion of the omentum. We have had from Dr. Fuller a statement in regard to the functions of the omentum; that whereever there is a lesion of the abdominal contents, a perforation, a perforating typhoid ulcer, a gunshot wound, for which a surgical operation is necessary, the function of the omentum is to assist the surgeon in closing that defect. Many of us for a great many years have used omental grafts for the purpose of strengthening the line of union in suture of the intestines, or where a portion of the intestine has been removed, or in closing defects of the bowel wall, we always endeavor to supplement the strength of union by omental grafts. The attachment of the omentum is of a temporary character, I think, in many cases. I have seen a number of cases in which there were adhesions of the omentum and when these abdomens were opened for some subsequent surgical procedure, all showed evidences of the former adhesions having disappeared, just as all evidence of adhesions between the intestines as the result of plastic peritonitis will disappear. So that I question the etiology of rotation as given by Dr. Fuller, citing these facts and merely expressing a mild sort of dissent from the dicta of Dr. Fuller as to the uniformity of the attachment of the omentum being the sole or principal cause.

Dr. John L. Yates, Milwaukee, Wis.: A case occurred at the Augustana Hospital about two years ago, the details of which were approximately these: The patient on admission to the hospital gave a typical history of subacute cholecy-

stitis, indicating the probable existence of stones. There was an elongated mass extending downward to the right side of the costal margin which on palpation and percussion simulated a Riedel's lobe, due to a distended gall-bladder. At the operation by Dr. A. J. Ochsner, the liver was found to be entirely normal, also the gall-bladder. There was no attachment distal to this mass, and the mass itself did not show any distinct indication at that time of torsion. It was very œdematous and showed apparently on microscopical examination evidences of what might be called omentitis, acute and subacute. There was no evidence of extension of this inflammation from the abdominal viscera to the omentum, so we presumed the probable explanation of this lesion was that torsion had taken place, from some unknown cause, giving rise to recurrent œdema. The torsion itself had disappeared. This œdema had persisted, and the resulting inflammation provoked an exudate which in turn caused crimping up of the omentum, forming a solid, hard mass in which there was no sign of suppuration and which was negative on microscopical examination as to bacteria. The patient made an uneventful recovery.

DR. ALEXANDER HUGH FERGUSON: I think, first of all, Dr. Fuller is to be complimented on going into this subject so thoroughly. A little over a year ago I had occasion to do likewise, on account of a case that I had of torsion of the great omentum. The patient was a woman forty-two years of age, the mother of six children, and weighed over 235 pounds. She was nearly six feet in height. The history she presented was that of a chronic condition referable to the stomach and bowels, and had been treated by a number of specialists and internists for stomach trouble and chronic diarrhœa. The chronic diarrhœa would last sometimes as long as a couple of months, and then subside. She would be constipated for a short time, improve for two or three weeks, and then the diarrhœa would come on again. Symptoms of partial obstruction of the bowels came on by degrees, but there was no stercoraceous vomiting at any time; there was never any persistent vomiting — in fact, vomiting was a minor element in the case. Nausea, however, was rather a constant symptom. The pelvic organs were normal. There was no pain particularly in the region of the appendix. There was no intra-abdominal tension except at times, and during these times she would have considerable pain. Exacerbations of pain came on rather severely and lasted for two or three days. There was more or less pain or uneasiness in the abdominal cavity all the time, particularly for the last year. She had traveled from sanitarium to sanitarium and was not relieved. The patient had indicanuria; indican was in the urine constantly. Her blood was normal. I could find no tumor. The abdomen was so thick and the woman was so stout and fleshy that I could palpate nothing but a fat abdominal wall. There was no hernia to be seen or felt. She had no attacks of inflammation in the abdomen. I opened the abdomen as an exploratory incision, having told her that the diagnosis lay between torsion of the omentum and some obscure form of internal hernia. Upon opening the abdomen in the median line, the first thing that presented itself was the blue small intestine. No omentum was to be seen or felt over the anterior surface of the abdominal contents. Upon passing my hand into the pelvis I felt the omentum behind the bowels. I followed it up in the direction of the appendix; it was not adherent to anything, but I found that it had pulled itself up over the junction of the small and large bowel. It was evident that the omentum was twisted as well as dislocated. The other portion of the omentum had passed completely around, via the junction of the duodenum and jejunum, and formed a large rope-like mass behind the small bowel. All I had to do was to untwist it and unfold it over to its normal position and there leave it. The woman has been cured of her stomach trouble and of her gastro-intestinal disturbances. This case disproves the assertion made in medical literature and also the statement made by Dr. Fuller to-night, that in order to have rotation of the omentum the other end must be fixed at some point.

In trying to find the cause for this particular relationship of the great omentum and the small intestine, I looked into the history of this woman very thoroughly, and the only thing I could find which might be an etiologic factor in the case was that she and her husband were thrown out of a buggy some years ago, and shortly thereafter gastro-intestinal symptoms began. The omentum was dislocated and torsion had probably taken place in obedience to the peristaltic action of the bowel. I am rather inclined to believe that peristaltic action of the bowels has every thing to do with torsions of the great omentum.

DR. FULLER (closing the discussion): The point raised by Drs. Steele and Ferguson regarding omental torsion without previously becoming adherent does not differ materially from the statement contained in my paper. I have admitted such a possibility, but am of the opinion that is it very rare.

The instance related by Dr. Ferguson in which there were no adhesions disclosed by the operation,

does not prove that in the beginning of the torsion there were no adhesions, for these may in any case be twisted off when the ometum has made a certain number of revolutions. If we accept Dr. Richardson's definition of omental torsion, the case recited by Dr. Ferguson could scarcely be deemed a torsion, because it remained in place when unrolled, and its removal was not necessary. This case would in all probability belong to the class in which the position of the omentum is merely an anomalous one as described by Dickenson and by Eccles.

The case reported by Dr. Yates is interesting, but in view of what little we know about torsion of the omentum, leaves some doubt as to the real nature of his case. We must remember that in order for a torsion to occur certain changes in the omentum must first take place. Factors of some kind must pedunculate the omentum at one or more points; similar or dissimilar influences or forces must rotate the pedunculated mass, which will twist the constricted points, interfere with the blood current passing through the vessels, producing an exudate which seals and holds together the several spirals of the pedicle, leading ultimately to strangulation of the distal omental tissue. In any case where the circulation in the pedicle is measurably altered the release of the torsion does not seem probable.

The discovery at operation of an omental torsion without adhesions at some point on the strangulated omental mass, would not necessarily imply that such a condition was initiated without the presence of adhesions. Without primary fixation of the omentum, pedicle formation is unaccounted for, and without a pedicle torsion would be difficult to explain.

## CHICAGO SURGICAL SOCIETY

A regular meeting was held, March 6, 1908, with the President, DR. A. J. OCHSNER, in the chair.

DR. WILLIAM E. SCHROEDER reported a case of empyema of an intrahepatic gall-bladder.

DRS. JOSEPH A. CAPPS and DEAN D. LEWIS presented a joint contribution entitled, Some Observations on Pleural Reflexes. (See page 243.)

### DISCUSSION

DR. JOHN P. LORD, of Omaha, Nebraska, was asked to open the discussion. He said: I am not only pleased, but gratified, to have this opportunity to attend a meeting of the Chicago Surgical Society, and thank you for the honor of addressing you.

I have not any distinct contribution to make to the subject in hand. I have, however, operated on several cases of empyema during this winter. The last case was that of a boy who died two hours after operation for resection of a rib and evacuating the left chest, which was quite filled with pus. He was very sick and quite emaciated, and the illness dated, at least, six weeks, which had been supposed to be due to other conditions than those found.

I am greatly impressed with the idea that the altered relation of these very vital organs, is suddenly brought about by the evacuation of so large an amount of fluid; and it seems to me that we must desist from the sudden evacuation of so large an accumulation, and devise some other means by which we can effect this drainage, and not produce so great an amount of disturbance. I had always believed that the irrigation of pleural cavities, and the deaths reported as resulting therefrom, were surgical bugaboos. It did not appeal to me that the mere irrigation would be responsible for that death, but it was the result of the sudden mechanical change within the chest. I I do not know that the literature has anything to say on that point, but I should presume a left-sided pleurisy, as in the case reported by me where the apex of the heart was under the right nipple, would give a larger proportion of these accidents than would a right-sided pleurisy. Of course, there is much that we do not know about this. This occurs to me, however, although the reports given in the literature and reported by the essayist do not clear that up. It would seem to me that the mechanical compression of the blood-vessels, perhaps obliterating their lumen in whole or in part, and possibly a thrombosis, arising as a result of this mechanical obstruction to the circulation, and the new relations might possibly liberate these thrombi, readily overlooked if a post-mortem examination is not as thorough as it should be. But like other surgeons in this regard, there is much about this that is mystery to me, and much that I desire to know.

I am impressed with the desirability of effecting less shock, mechanically produced, by this sudden mechanical evacuation of large accumulations from the chest.

DR. JOSEPH A. CAPPS: Dr. Lewis has well covered the surgical phases of this subject. There are some matters, however, of especial interest to the internist, which will bear further discussion.

We tried to repeat these animal experiments, as far as feasible, in the human being. We tried direct irritation of the pleura at the time of aspiration in cases of pleuritis, both serous and purulent, recording the blood-pressure changes throughout the procedure. The trocar, after being inserted, was moved on the visceral pleura. It was done with great caution. There were ten cases in which we tried this method carefully, watching the blood-pressure to see that we did not cause any great degree of shock. Of the ten cases, there were five which gave no result, that is, there was no appreciable fall in blood-pressure. In two other cases there was a moderate fall in blood-pressure. In one case the blood pressure was 100 m.m. Hg., and it fell, during scratching of the visceral pleura, which could be distinctly felt by the trocar, to 80 m.m. Hg., and then the reading came back to normal, when the irritation was discontinued. In one case of emypema the drop was considerable, from 105 m.m. Hg., down to 75 m.m. Hg. When the operator inserted the needle he was unable to get fluid, but by turning the needle in different directions he succeeded. When the trocar was being moved over the visceral pleura during the exploration, the fall in blood-pressure occurred. In another case of pleurisy with an initial blood-pressure of 89 m.m. Hg., withdrawal of 1,200 c.c. of bloody fluid was followed by a lowering of pressure to 69 m.m. Hg. Then the trocar came in contact with the visceral pleura and, although no more fluid escaped, the blood-pressure fell rapidly to 57 m.m. Hg., and the patient complained of faintness and dizziness and a dull pain at the site of the trocar. In three minutes after removal of the trocar, the pressure was 62 m.m. Hg., and thirty minutes later 80 m.m. Hg.

We have come to the conclusion from our animal experiments and from these human observations, that the disturbance of physical conditions in the chest during aspiration are not so important as the degree of irritation of the visceral pleura.

Another question comes up, to which Dr. Lewis alluded, namely, what part does the parietal pleura play in the reflex so often observed during the passage of the trocar through the chest wall, or does it play any part at all ? We have carried on experiments to settle this question by dissecting out the parietal pleura, exposing it and trying various forms of irritation, to see what effect they have on blood-pressure and respiration. It is surprising in normal dogs to find how resistant the parietal pleura is in its response to stimulation, so far as blood-pressure is concerned. It makes no difference in blood-pressure when you scratch the parietal pleura, or when you add mustard oil, or formalin, iodine, or hydrogen peroxide. The only distinct reaction we were successful in producing was by the faradic current, and this, we believe, is due to the touching of some branch of the intercostal nerves which supply the parietal pleura. It is well known that electrical stimulation of the proximal end of the vagus nerve in a certain percentage of cases induces a fall in blood-pressure, which is attributed to the stimulation of afferent depressor nerve fibers. Similar depressor nerves may exist in other nerve trunks. The intercostal nerves may be so peculiar in this respect, as compared with the other nerves of the body, that depressor influences are easily elicited.

At the time the trocar is forced through the chest wall there may be a sudden cessation of respiration, with a sudden drop in blood-pressure, and it is reasonable to suppose that some of the tissues injured in this process give rise to the depressor effect. What tissues are responsible for this?

We found that trauma of the skin, or the intercostal muscles, or the parietal pleura, individually, seldom caused a disturbance of blood-pressure. Moreover, it was evident that the amount of force used, and the degree of compression of the chest resulting, were important factors in producing the fall in pressure.

Now, it is difficult to explain such a lowering of pressure by the restriction of the thoracic space from the pressure inward of the ribs. A liberal estimate would not make the contraction of the thoracic cavity more than ten or fifteen per cent, and we know that one can tie off a whole lobe or two lobes of the lung, constricting the respiratory capacity thirty per cent, without causing any such effect. A pneumothorax, which disables one side entirely, does not immediately lower blood-pressure. The reflex must be due to something independent of mere limitation of chest capacity. This suggests the experiments of Crile, on shock, in which, you may recall, he took a hammer and gave a sharp stroke upon the different parts of the chest and found there was a sharp fall in blood-pressure, with cessation of respiration. He found this most marked in the lower part of the chest, and found it marked, also, from a blow on the epigastrium, if the stroke was made upward toward the diaphragm. He concluded that the cause was due to direct mechanical influence upon the heart itself. This explanation does not seem altogether applicable to our experiments, for, at times, pressure in the second interspace of the right side far away from the heart region, was sufficient to bring on a marked depressor effect. In one experiment in a case of pleurisy in a dog,

where strong pressure was exerted by a blunt point in the second interspace on the right side, and continued for ten seconds, the dog died. There was no penetration. In normal dogs we never have seen such an accident occur. It is the pleurisy dog which is apt to be hypersensitive to the depressor influence, and we believe that this particular depressor effect is due to some injury — it may be stretching — of the depressor nerves, which, apparently, are abundant in the chest wall.

One other matter may be dwelt on further, and that is, the effect of irritation of the pleural cavity with various antiseptics.

We tried a series of normal dogs as controls for the pleurisy dogs. These experiments are not yet complete, but there are some interesting results which seem worth mentioning. For instance, we find the injection of Lugol's solution, 5 or 10 per cent solution, has no ill effect in either normal dogs or pleurisy dogs. We find the injection of formalin, either a strong or weak solution, or one of 5 per cent in glycerine, does not often cause a depressor reflex in normal dogs, but rather frequently does in pleuritic dogs, say in some 15 or 20 per cent of the cases. Mustard oil nearly always produces a reflex in normal dogs, as well as in pleuritic dogs.

A very interesting observation was alluded to by Dr. Lewis, namely, the fact that hydrogen peroxide injected into the normal pleural cavity produced no effect in 5 dogs, whereas in 4 dogs with pleurisy, it produced a depressor effect, which was fatal in 3 of the 4 cases. This recalls some instances in which death has occurred after washing out an empyema with hydrogen peroxide. Janeway reported a case of death, which he attributed to some form of gas embolism. It is probable that this death was caused by irritation of the pleura by the peroxide of hydrogen.

If washing out the pleural cavity with certain antiseptic solutions is such a dangerous thing in dogs, why do we not have more accidents in our clinical work ? There is a risk attending their use. The reason that accidents are not more common is because in old empyemas, fortunately, there is a thick pleural exudate, and the thick exudate protects the pleura. But who knows when a piece of exudate may come off and, by exposing a portion of the pleura, give rise to a dangerous reflex ? In the light of our experiments, both with the reflex that comes from the chest wall and the far more important reflex which comes from the visceral pleura, there is need of caution in such procedures.

In answer to Dr. Lord, concerning the relative frequency of sudden death, following operations upon empyemas of the left and right side, it does not seem to make any difference. The sudden deaths cannot be explained upon mechanical conditions, such as depression of the diaphragm with a kinking of the inferior vena cava, for a number of cases have occurred in which a relatively small pleural abscess well walled off, thus preventing a pneumothorax, has been opened.

Undoubtedly, some of the sudden deaths occurring with enormous pleural exudates, in which collapse followed a change in the position of the patient, are due to depression of the diaphragm with sudden kinking of the inferior vena cava. Rosenbach, sometime ago, suggested this explanation for sudden deaths occurring when no operative interference had been instituted.

# BOOK REVIEWS

KEEN'S SURGERY. Its Principles and Practice. By various authors. Edited by William Williams Keen. Volume II, with 572 text-illustrations and 9 colored plates; and Volume III, with 562 text-illustrations and 10 colored plates. Philadelphia: W. B. Saunders Company.

The second and third volumes of "Keen's Surgery" more than maintain the high standard set by the first. Nearly all the chapters are uniformly good, and writtten by men whose work is authoritative. The system will be among the most perfectly illustrated of its kind, the illustrations being not only abundant and well-executed, but really instructive and explanatory, rather than merely thrown in in profusion. Many of the chapters are very complete monographs on the subjects of which they treat. The insertion of a bibliography at the end of each chapter is one of the really valuable features.

Among the twenty chapters of which the two volumes are made up, none is really poor; nearly all are excellent.

The chapters on Fractures and Dislocations, by Dr. Daniel N. Eisendrath, are particularly well written, and are supplemented with a wealth of elucidating illustrations that leave little to be desired.

Orthopedic Surgery, by Lovett, is a concise textbook in itself, of 215 pages.

Five chapters are devoted to surgery of the nervous system, covering 460 pages. Two hundred and sixty pages are by Harvey Cushing on the surgery of the head; also two chapters by Geo. Woolsey on the spine and nerves. Altogether, the entire subject of the surgery of the nervous system is well worked out, perfectly illustrated, and abreast of the current literature on the subject.

Chapters on the Neck, by E. Wyllys Andrews; on the Thyroid Gland, by Albert Kocher; on the Breast, by John M. T. Finney; and on the Tongue, by John Chalmers Da Costa, are all concise, but complete, monographs, uniformly excellent.

Abdominal Surgery, by John C. Munro; the Stomach, by Mayo Robson; the Liver, Gall-Bladder, and Biliary Tracts, by the Mayos; and the Pancreas and Spleen by Moynihan; are of the type of production that one would expect from such men.

Throughout the work there is an orginality and freshness that speaks for active work by the authors rather than compilations by assistants. A notable feature is the absence of a padding of methods described and pictured in the tomes of by-gone times, which no surgeon considers to-day, but which even recent text-books have seemed to think necesssary to include to give the idea of completeness.

The mechanical features of the work are excellent. The volumes are of a satisfactory size, in good, clear type, on enameled paper, well bound.

THE INTERNAL SECRETIONS AND THE PRACTICE OF MEDICINE. By Charles E. deM. Sajous, M.D. Vol. ii. Philadelphia: F. A. Davis Company. 1907.

Four years have elapsed since the publication of the first volume of Dr. Sajous' special treatise on the internal secretions. We are not surprised at the delay incidental to the production and publication of this volume. Considering the enormous amount of material collected and incorporated into this volume of nearly 1,900 pages, the wonder must be, not that there has been delay but that the task has been accomplished in so short a space of time; especially when there is taken into account the difficulties of hypothesizing in any consistent way on such a mass of material. Dr. Sajous is the arch-advocate of the supremacy of the ductless glands in physiology. Since the days of Brown-Sequard, the development of our knowledge of these organs and its incorporation into the teachings of physiology has given rise to the designation "newer physiology." A still more superlative term would fail to do justice to the novelty of Dr. Sajous' views or to the ingenuousness with which he puts them forth. The author is naïvely anxious that the reader shall be duly impressed that "not a single conclusion presented in this work is theoretical"— a statement which is emphasized and italicized in this introductory chapter. We admire Dr. Sajous' industry and his devotion to the thesis that he has set himself to prove. The place of the internal secretions in nutrition is undoubtedly an important one and we are still far from a full realization of their share in the body processes. It is doubtful, however, if such works as the one before us will materially assist in advancing our knowledge in this direction. Dr. Sajous' book

despite his prefatory claim is built largely of hypothesis and special theory — he seems to have made the cloth fit his garment and not his garment the cloth. A. R. E.

BIER'S HYPÆREMIC TREATMENT. By Willy Meyer, M. D., Professor of Surgery at the New York Post-Graduate Medical School and Hospital, Attending Surgeon to the German Hospital, Consulting Surgeon to the New York Skin and Cancer Hospital, and to the New York Infirmary; and Prof. Dr. Victor Schmieden, Assistant to Professor Bier, University of Berlin, Germany. Illustrated. Philadelphia and London: W. B. Saunders Co.

This excellent little volume of 200 pages is designed to give the general practitioner a thorough understanding as to the scope of this new therapeutic agent and the method of its application. Written by Dr. Willy Meyer, who has long been identified with this method of treatment in this country, and Dr. Victor Schmieden, who was originally an assistant to Bier, it cannot fail to attract the attention which this authoritative authorship justifies.

Seventy-six pages are given up to the discussion of various technical procedures, while the remainder of the book discusses the application of the method to various diseases in which it has been found applicable. The descriptions are clear and concise. The work seldom errs on the side of excessive partizanship, which is so often characteristic of writings on new subjects.

It is not a translation of Bier's own work, but takes advantage of all of his writings and adds to this the personal experience of the authors. The book is in every way a credit to the authors and to the publishers, and while one misses the proof of the efficacy of the method in the various diseases, which could have been furnished by tabulated results, it is probably wise that this was omitted, since the procedure is not as yet fully accepted and it will probably be modified and limited in its application more in the future than it has been in the past.

## BOOKS RECEIVED

GLANDULAR ENLARGEMENT AND OTHER DISEASES OF THE LYMPHATIC SYSTEM. By Arthur Edmunds, M. B., M. D., B. Sc., Lond. London: Henry Frowde, Oxford University Press, 1908.

THE PRACTICAL MEDICINE SERIES. Comprising ten volumes. GENERAL SURGERY 1908, Volume II. Edited by J. B. Murphy, A. M., M. D., LL. D. Chicago: The Year Book Publishers. Price, $2.00 per volume.

THE ESSENTIAL SIMILARITY OF INNOCENT AND MALIGNANT TUMORS. By Charles W. Cathcart, M. A., M. B., C. M., F. R. C. S., Edinburgh, Scotland. Bristol: John Wright & Co., 1908.

AMERICAN PRACTICE OF SURGERY. Editors, Joseph D. Bryant, M. D., LL. D. and Albert H. Buck, M. D. Complete in 8 volumes. Volume IV. New York: William Wood & Company, 1908.

ORTHOPEDIC SURGERY. By Bradford & Lovett. New York: William Wood & Company, 1908.

MORTALITY STATISTICS. 1906. Seventh Annual Report, Department of Commerce and Labor, S. N. D. North, Directors, Washington: Government Printing Office, 1908.

A SHORT PRACTICE OF GYNECOLOGY. By Henry Jellett, B. A., M. D., F. R. C. P. I., Dublin. London: J. & A. Churchill, Philadelphia, P. Blakiston's Son & Co. Price, $5.00, net.

FOLIA THERAPEUTICA. Edited by A. Baginsky, M. D., and J. Snowman, M. D., M. R. C. P. London: John Bale, Sons and Danielsson, Ltd. Price, one shilling. 1908. (Quarterly).

ABDOMINAL TUBERCULOSIS. By A. Ernest Maylard, M. B., B. S. (Lond.) Philadelphia: P. Blakiston's Son & Co., 1908. Price, $4.00, net.

MANUAL OF SURGERY. By Alexis Thomson, F.R.C.S., Ed. and Alexander Miles, F. R. C. S., Ed. Volume I, General Surgery: Volume II, Regional Surgery. Second Edition, revised and enlarged. Philadelphia and London: J. B. Lippincott Company. 1908. Price, $5.00 per set, net.

ROTUNDA MIDWIFERY FOR NURSES AND MIDWIVES. By G. T. Wrench, M.D. With introduction by the Master of the Rotunda Hospital, London, Henry Frowde, Oxford University Press. Hodder and Stoughton, London. 1908.

PROGRESSIVE MEDICINE. Edited by Hobart Amory Hare, M. D. and H. R. M. Landis, M. D. Vol. i., March, 1908. Philadelphia and New York: Lea & Febiger, 1908.

AN INDEX OF TREATMENT. By various writers. Edited by Robert Hutchison, M. D., F. R. C. P., H. Stansfield Collier, F. R. C. S., and Revised to conform to American usage by Warren Coleman, M. D. New York: William Wood & Company. 1908.